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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

TWENTY-FIFTH ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

GENERAL ANNOUNCEMENT.

AMERICAN GAS LIGHT ASSOCIATION,
OFFICE OF THE SECRETARY,
MONTCLAIR, N. J., Sept. 13, 1897.

There will be an annual meeting of the American Gas Light Association held in Old Point Comfort, Va., on October 20, 21 and 22, 1897.

The meeting will be called to order by the President, Mr. Chas. H. Nettleton, of Derby, Conn., at 9:30 o'clock A.M., Wednesday, October 20, in the meeting hall of the Hotel Chamberlin, the headquarters.

The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in so doing a reply should be requested, for which a self-addressed, stamped envelope should be inclosed, as misunderstandings may thereby be averted.

The Chamberlin is conducted on the American plan, and the rates will be as follows: $3 per day for single room without bath; $4 for single room with bath; $3 for each person, in double room without bath; $4 for each person, in double room with bath.

The Hygeia Hotel, directly across the street from the Chamberlin, gives the same rates.

The meeting hall will be the dancing hall of the Hotel Chamberlin; thus the headquarters and the hall will be in the same building.

The Roll Call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as it appears on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of Application for Membership accompanies this circular. More can be obtained of the Secretary.

Remember, all applications must be in the Secretary's hands by Oct. 10, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at this meeting is as follows:

"Some Further Experiments on Interior Illumination," by Mr. Alten S. Miller, Long Island City, N. Y.

"Chemical Notes on Purification," by Mr. Henry A. Mather, Brooklyn, N. Y.

"Gas Advertising," by Mr. R. M. Searle, Atlanta, Ga.

"A Report on Burner Stoppages," by Mr. Paul Doty, Long Branch, N. J.

A paper by Mr. K. M. Mitchell, St. Joseph, Mo., giving an account of a method successfully employed by him to obviate trouble from naphthaline.

"A Quadruplex Purifying Box: Why Not?" by Mr. F. H. Shelton, Chicago, Ills.

"Iron Rust in House Pipes," by Mr. F. B. Wheeler, Long Branch, N. J.

In addition to the above the following topics will be brought in for discussion by short written introductions:

"Leakage."

"An Experience in Oil Storage."

"Notes on Main Pipe Laying."

"How can we Extend the Use of Gas for Culinary Purposes beyond the Heated Season?"

All questions for the Question Box should be sent in to the Secretary as soon as possible, in order that they may be printed in the next circular before the meeting, thereby insuring their discussion.

During the days of the meeting all announcements will be posted on the Bulletin Board in the meeting room. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested to wear their membership badges in plain sight, thereby greatly aiding the officers and the local committee in their work, by affording a ready means of recognition.

In order that the Year Book containing the report of this meeting may be published and issued to the members immediately after the meeting, notice is hereby given, that if any of the speakers at the meeting desire to correct their remarks in discussions before they are printed, they will be given an opportunity before leaving Old Point, but *not* after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the

meetings, and all those who desire to correct their remarks *must* notify the Secretary at the close of the session at which such remarks are made, as all the report will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare going and one-third fare returning by the same route), by the several Passenger Associations named, and under the conditions noted.

The Trunk Line Passenger Committee, covering territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N. Y.; Pittsburg, Pa.; Bellaire, Ohio; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Southeastern Passenger Association, covering the territory south and west of the Virginias, and south and east of the Ohio and Mississippi Rivers.

The Central Passenger Committee, covering the following grounds: Bounded on the east, by Pittsburg, Salamanca, Buffalo and Toronto; on the north, by the line of and including points on the Grand Trunk Railway, from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook County, Illinois; on the west, by the west line of Cook County and the Illinois and Mississippi Rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio River, including points on either side of that river.

The Western Passenger Association, covering the territory west of and not including Chicago, Peoria and St. Louis—in other words, the territory west of that of the Central Association—have refused to grant the rate. Members from this territory should buy tickets from starting point to the nearest or most convenient point in the territory of any of the Associations granting the reduced rate, and at such point purchase tickets through to Old Point Comfort and obtain a certificate.

The following extracts from the regulations of the railroads are cited for the information of the members. The special rates are granted subject to these regulations.

First.—The reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.

Second.—Each person, to obtain the excursion rate, must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form. Agents at all important stations are supplied with certificates.

Third.—If through tickets cannot be procured at the starting point, purchase short-trip ticket to the most convenient point where such through tickets can be obtained, and there purchase through to place of meeting, requesting a certificate from the ticket agent at the point where each purchase is made.

Fourth.—Tickets for the return journey will be sold by the ticket agent at the place of meeting at one-third the highest limited fare, only to those holding certificates signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary of the Association, certifying that the holder has been in regular attendance at the meeting.

Fifth.—No reduction of fare will be made on the return passage, if the going ticket is purchased more than three days before the opening date of the meeting; except that when meetings are held at distant points, to which the authorized limit is greater than three days, tickets may be purchased before the meeting in accordance with the limits shown in regular tariffs.

Sixth.—Certificates are not transferable, and return tickets secured upon certificates are not transferable. The transfer of any such is liable to prevent the securing of reduced rates for future meetings.

Seventh.—The certificate of agent at starting point, duly endorsed by Secretary of Association, must be presented to ticket agent at place of meeting, within three days (*Sunday* not reckoned, except by Southern Passenger Association), after adjournment of meeting. The return ticket will be for the line or lines covered by the going ticket.

Eighth.—No refund of fare will be made on account of any person failing to obtain a certificate.

The Old Dominion Steamship Company have also granted a round-trip fare of $10 from New York to Old Point. This includes stateroom and meals both ways.

SPECIAL.

Be sure to obtain a railroad certificate when buying your ticket for Old Point, as the greater the number of certificates handed in the easier it is to get the reduction in rates next year. Apply for ticket and certificate at least 30 minutes before train time. Each person must sign his own certificate at time of purchasing ticket for Old Point. Be sure to have the Secretary endorse your certificate at Old Point as soon as you get there. Apply for return ticket at least 30 minutes before train time, and have your certificate with you. Any person, ladies included, attending the meeting, is entitled to the reduced rate from the territories named. Members will please hand their certificates to the Secretary, or his clerk, upon arrival at place of meeting. If there are 100 members present, holding certificates, each certificate will then be properly endorsed and handed back to owner, before adjournment.

If a sufficient number of subscriptions are obtained there will be a banquet at the Hotel Chamberlin, Thursday evening, October 21, and an excursion on the waters of Hampton Roads and the James River, on Friday, October 22. Tickets admitting member to banquet and, with ladies accompanying him, to the excursion can be had for $5. If you wish to join in these entertainments please sign enclosed card and mail it to the Secretary at once. It will be necessary to have at least 100 subscriptions to make them successful.

ALFRED E. FORSTALL, Secretary.

Extracts from the Constitution.

SEC. 12. Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.

SEC. 51. No member who owes two years dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

SEC. 52. Any member whose dues shall remain unpaid for a term of three years, may be dropped from the roll of membership by a vote of the Council.

BRIEFLY TOLD.

ADDITIONS TO THE PROGRAMME OF THE MEETING OF THE AMERICAN ASSOCIATION.—Secretary Forstall's current circular shows that no effort is being spared to increase the technical value of the Old Point Comfort meeting of the American Association, for the revised paper list shows an unveilment and an addition as well. The unveiling is instanced in the naming of Mr. F. H. Shelton, who has prepared a paper with the compound declarative-interrogative title of "A Quadruplex Purifying Box: Why Not?" A rough-and-ready analysis of the gas purifying situation of to-day leads to the offhand reply: "Certainly; since such a box has been well tried, without having been found wanting." However, the paper should lead to a lively discussion, because many will be found to oppose the plan, likely on the ground that the ordinary "box man" is more inclined to simplicity than towards complexity. In other words, being simple himself, he could better be trusted to direct a tandem than a four-in-hand. The addition to the paper list is a number by Mr. F. B. Wheeler, of Long Branch, N.J., on "Iron Rust in House Pipes;" deposits that are, more's the pity, too frequently in evidence, particularly when pressure systems that have been all too long in practice are suddenly changed. Mr. Wheeler is methodical and accurate, wherefore his presentation of the experience gained in the line noted, through practical observation of results seen in the changed conditions of gas supply, on the Southeastern Coast of New Jersey, between 1895 and 1897, should and will be well worth hearing. The list of short topics for discussion embraces so far a quadrature that voiceless solvers might well study for long without hope of solving. The titles of the questions are simplicity themselves; but the gaining of the outcome suggested by each is complexity enough to provoke lively discussion. With the list as announced, none may fear that the Old Point Comfort meeting, from a technical point of view, can be other than interesting and instructive. The subscriptions to the outing have come in so liberally that all doubt as to the completeness and carrying out thereof, in proper and enjoying order, is at an end. The admonition to secure traveling accommodations well in advance, by those who propose to travel by boat from New York, are repeated; and we here note, having been spurred thereto by a correspondent who knows Old Point pretty well, that overcoats for "the one" and wraps for "the other" will not at all be out of place.

SPIGOT AND BUNGHOLE.—During the last week in September the Committee on Gas of Philadelphia Councils had under consideration the matter of the sums that should be set aside for the maintenance and conduction of the municipal gas works. On the whole, the Committee did fairly well in its allotments, for a round increase in the appropriations for this year over those for the coming year was granted; nevertheless, quite a bit of picayuneishness was brought out in the debate over the separate items in the budget—some account of the proceedings will be found in our current item columns. The littleness of some of the objections may be appreciated when it is said that, when the chapter covering "miscellaneous salaries" was reached, one reformer, who protested that the asked-for sum ($192,388) exceeded that of the current year by $1,000, could only be pacified by a statement from the Assistant Director of Public Works (Mr. Quick) that the $19.50 per week emolument was required to pay for the services of a draughtsman, whose work was absolutely required, else the work that he did would have to be purchased piecemeal at a very much higher ultimate cost. The second "little" objection was on the proposition to *increase* the salary of the Superintendent of the Frankford station from $960 to $1,200 per annum. If the objectors on either of these scores wished to save the money that the named cases involved, as to salary, they could do so, and many times over, by simply seeing to it that the leaks in the gas mains, in many a half mile stretch of the Philadelphia gas works' pipes, were stopped. The gas thus saved would beyond a doubt more than return the draughtsman's salary and give to the Frankford station Superintendent the additional $5 per week that his services would seem to be worth—if such services are worth anything at all.

[Prepared for the JOURNAL.]

Some Modern Devices for Securing High Temperatures.

By DR. W. H. BIRCHMORE.

To him who has occasion to go about in New York city among the class of trades and professions, in which an easy and inexpensive way of obtaining and maintaining very high temperatures for a period more or less prolonged (for which process I have used the word "securing"), nothing appears more impressive than the variety of the appliances used for this purpose. This variety is, to use a familiar phrase, both qualitative and quantitative. There is a surprising variation in the definition of a high temperature, a greater diversity in the means of obtaining it, a startling neglect in the influence of the surroundings, and a total disregard of all questions of economy, both in the expenditure of fuel in proportion to the work done and in regard to the waste resulting to the product. To see 6 inches of iron pipe melted by oxide production and slagging in the making of a single weld does not impress the bystander as being workmanlike, however it may strike the employer, when the said bystander sees that the waste is caused by the character of the flame, which is acid, containing free oxygen, when it should have been at least neutral, or better have contained an excess of carbon. To see a man using a forge which undoes the work of the manufacturer of the iron which is being heated in it is hardly the way to convince a foreigner of the superior judgment, whatever he may think of the skill, of an American workman. Be this as it may, I have seen 153 pounds of slag, 60 per cent. metallic iron, produced in 9 hours' work in a certain pipe welding establishment in this city.

In my walks about the city I have seen and studied dozens, perhaps hundreds, of the high temperature devices, and each day's thinking has convinced me that an account and resumé of what I had seen would have a value; not great, it is true, but appreciable.

The oldest of the many devices for obtaining intense heat is the one which survives to this day in the common forge. It is true that the charcoal has given place to a less expensive fuel, and the old-fashioned bellows to the centrifugal blower, but the principles involved are the same; and he who sees the modern tool sharpener or rivet heater on a modern structure sees Vulcan forging the thunderbolts of Olympian Jove. A small use of the imagination is needed to be sure; but he who has watched the cutler in the Italian quarter, forging knives on an anvil, and heating and tempering them in the forge and water bucket, has seen Siegfried making the sword with which he slew Fafnir and acquired the accursed gold. So little has time changed the tools of the most important of all human arts, the working of iron. But while these are instances of the survival of ancient methods into the present century, they are hardly more than survivals; and the introduction of liquid and gaseous fuels, specially the latter, has produced appliances whose name is legion.

Modern art and modern science recognize the fact that a distinction must be made between the processes which are simply heating things and those which imply the use of fire which has a definite chemical composition. This brings at once a fundamental distinction into play in reference to any classification of the appliances of distinctly modern type. It is not my intention to attempt to describe the enormous furnaces which are seen in the huge industries, but only the small ones, such as may be seen any day in the small workshops and laboratories. These are quite as interesting as the greater ones, scientifically considered, and much more amenable to the treatment which I have in view.

These may be divided into those using gaseous and those using liquid fuel, but the other, and primary, distinction must not be lost sight of—the division into those which are simply means of making things hot, and those that imply, either intentionally or by accident, a chemical operation of greater or less importance.

As typical of the appliance for heating things is the form of burner seen in kitchens, heating griddles, and in laundries and other places, heating flat irons or water. These consist of tubes of cast iron, slitted at equal distances, sometimes closed at one end, more frequently open at both. The gas (usually common illuminating gas) is delivered from a nozzle at one end and is supposed to form in the tube a mixture of air and gas of the desired quality, and is lighted above the slots, from each of which proceeds a tongue of flame. The better form of this device is closed at the distal end and the air allowed to enter only from the end adjacent to the gas jet. This is about as rude a machine as one can well imagine, but its cheapness has given it great vogue.

It has one marked defect; it cannot be "turned down." It must either be burned to the full or it must be extinguished.

There are a number of modifications of this type, a few of which are certainly to be regarded as ingenious and workmanlike. One of these is so arranged that the turning down of the gas supply also closes a proportionate number of the openings, thus maintaining the proportion of the inside pressure. The advantage of this is to insure against the nuisance of "lighting back." Both forms of this burner may be seen in gas cooking stoves, but they are usually fitted with the ruder and cheaper fixture.

When both gas and air under pressure are available, as in many manufactures, a curious form of this appliance is frequently met, in which the air is supplied under pressure. In this case the burners are in the simplest form very liable to be extinguished, but I have recently seen one in which the gas supply and air supply and number of openings were all under control at the same time.

This very curious arrangement was used for heating water in a "locomotive boiler" in a laundry. The "engineer" told me the economy was perfect. He never raised more than 3 pounds of steam, just enough to deliver the water under pressure at all parts of the establishment, and when the demand was small, instead of extinguishing any one of the burners, which would have been difficult to relight, he turned a jacket tube around the burner, which cut off five in every six of the slots, and at the same time reduced the supply of air and gas. To raise the burner to its full power he first turned in the air and gas supply and then turned off his jacket tube, which caused the flame to spread and thus to light from burner to burner without any explosive action. This machine had the slots at right angles to the axis of the inner tube; had they been parallel the arrangement would have been nearly ideal. Extensive inquiry has failed to find any manufacturer of such a burner. Yet a perfected device of this kind would be an ideal way of using gaseous fuel. I asked how he maintained his air pressure, and found it was by a small pressure blower belted to the gas engine which drove all the machinery. That is the highest development of this type I have seen.

Another interesting burner of the same general species is in common use for heating glue pots. I saw one blast burner used for melting copper, which struck me as interesting. It consisted of a box made of 4-inch gas pipe with a cap on either end. In the cap on top were 36 one-half inch holes, and through each, nearly to the surface, came 36 three-sixteenth inch brass tubes, which passed airtight through the bottom, and were secured into a similar box below. Gas from a large pipe was admitted into the upper box and air under pressure into the lower. These two boxes were surrounded by a piece of round chimney pipe, and the crucible was supported by an iron triangle on the top. Rude as the machine was, there could be no doubt of its efficiency; but the method of supporting the crucible was certainly bad. Why the inventor had not made the burner the full size of the pipe, and supported his crucible from the bottom on a piece of brick, was not clear to me. Here also is the germ of a useful invention.

Another curious makeshift was a furnace for making small castings. Here, instead of supplying the air just at the point of cumbustion, the two were mixed as in a Bunsen burner. The material used was of low fusing point, so the temperature obtained was sufficient; but the holes in the cap were small (only ½ inch), and I do not know the number. The defect in this was that when it had been burning for a long time the top got red hot, and then the burner would light back, with a report like a young cannon, as it did while I was in the shop, which led to my examination of it.

I have no idea how many queer forges for brazing I have seen, but the most remarkable consisted of a hollow brick, such as is used for flat and fireproof flooring, sawn in two lengthwise, and the long portion in the segments broken away. This made a box 8 inches cube; into the cut was placed a tile ¾ inch thick, leaving a space ¾ inch wide and 4 inches deep when the segments were brought together, which they were when the machine was in use. Into either piece entered a 1¼-inch iron pipe, 8 inches long, closed at one end with a cap, and supplied by a ¼-inch gas pipe connected to the gas system by rubber tubing. Through the cap passed a ¼-inch gas pipe, also with rubber connections, for the air supply. This came from a common kitchen "hot water boiler," used as a reservoir. The air was pumped into this to a pressure of 100 pounds to the square inch—a fact; for I saw the gauge and afterward tested it. A valve of the Pintsch pattern reduced the supply to 5 pounds, more or less; I could not test this. Of course this made two enormous Bunsen burners, and as the flames met end on they filled the box full. With this appliance a workman was brazing the frames of bicycles. The owner of the shop said the whole thing cost less than $3, and a good brazing forge would have cost at least $25. I did not inquire if he regarded it as economical in operation, but I know I did not.

In the same shop another piece of apparatus caught my attention. It

was a forge, suggesting in its arrangement the famous "Woolwich Forge" of Mr. Fletcher. This consisted of a square flue-pipe, 8 inches across and 6 inches deep, into which one of the burners previously described was introduced. The bottom was made of bricks. Into the side was introduced one of the enormous Bunsen burners previously described. The box was well filled with coke of not large size, and the whole mass was nearly white hot. The man using the forge was evidently an expert hammer master, and was making tools of various sorts, and tempering cold chisels by the dozen. I asked the use of the coke, which I saw was not being used as fuel, and was informed that it was used to keep the gas from burning the steel. This was not exactly intelligible to me, but by questioning I found that, in order to keep the flame non-luminous and sufficiently hot, an excess of air was needed, which, of course, made the flame intensely oxygenating. To avoid this result the forge was filled with coke, which burned off the excess of the air and also "held the heat." The user said the charge was renewed about once in a month; he "added a little as he thought he needed it, and it always burned up clean."

The gasoline gas apparatus has so few users in the city that I have met no interesting developments, but in an adjacent village I have seen one. The manufactory in question was originally lighted by a gasoline air-gas plant, but this had been displaced by the incandescent filament lamps for illumination purposes, and was now used for heating only. The "mixer," which was not of the automatic type, had been adjusted to furnish a "richer gas" than the regular 16 per cent. mixture. A sample bottle I carried away showed 23.4 per cent. hydrocarbon vapors.

The work required was melting and brazing, the metals used being almost exclusively brass and a zinc alloy, which was nearly white. The melting furnace was the curiosity in this instance. A large cast iron burner had been made in what may be briefly described as the Fletcher pattern; the gas was conveyed to it by a ½ inch pipe, and the air by another. The peculiarity was this, when the burner was first lighted the gas supply was decreased and the air supply turned low; consequently the flame was not large, although very hot. This was used until the whole of the crucible and the inside of the furnace were bright red, but by no means hot enough to fuse and make the alloy. When this stage was reached the gas was turned on full and the air pressure greatly increased. This extinguished the flame at the burner—blew it away, in point of fact; but when the pressure was lessened by distance and expansion, as it was in the furnace pot a few inches, about four, from the surface of the burner, the mixture inflamed from the surface heat and filled the chamber with an invisible flame, the power of which must be seen to be even imagined. The furnace pot was a Battersea crucible, and it showed signs of incipient fusion. I was told that this peculiar handling was to insure an atmosphere which should contain no uncombined oxygen, or "free air," to use the melter's phrase. It would seem as if here also were the germ of a useful invention.

From gasoline air-gas to fluid burners is but a step, and yet it crosses a wide chasm. Gasoline (74°) is quite easily loaded into air currents at workshop temperatures; but the other, and heavier, far more efficient hydrocarbons, like refined kerosene, must be vaporized by heat. I have seen only one device which struck me as showing special ingenuity. Of course the burner for the regular fuel oil steam or air injector furnaces are not in this list.

The furnace in question had been designed to burn illuminating gas, but either the small efficiency or the greater cost had induced the change, which might be described as a combination of a fuel-oil (although kerosene was used) and a gas furnace. In this case the furnace pot consisted of a Battersea crucible as before; but the firebox was another structure. The same material (the flat arch terra cotta) elements were used. The side and bottom of the crucible had been cut away and the middle piece formed a bridge. A cap was placed over the crucible and a pipe carried to a flue, which made a tremendous draft. Playing against the bridge, the surface of which it rapidly heated to incandescence, was a gas-fed blast Bunsen of the pattern described for heating the boiler, only miniature.

The oil was driven through four small nozzles upon this bridge, and two tuyeres supplied air under pressure at about the level of the top. These were adjustable, and their position was changed according to the amount of oil supplied. Apparently the change was by rule of thumb, for I could not discover, nor could the user tell me, the rule by which he gauged the position or supply. He only knew that he "fixed the machine to give the hottest flame." I found this flame to be practically neutral to iron, and slightly reducing to manganese borax glass in a platinum spoon.

It really gives one a most exalted sense of the genius of mind which follows well trained fingers to see from what paltry and almost impracticable materials some of these almost perfect appliances were constructed; perfect, that is, from the standpoint of the special end desired. I do not think that any one of these described, except the boiler, really came anywhere near a rational design or the best practical economy of operation; but, one and all, like Tybalt's thrust at Mercutio, "it serves."

Turning from these to the laboratory appliances, I do not see that improvement and perfectionment in design and execution which we would certainly be justified in expecting. There are two patterns of injector furnaces in common use in laboratories, and the users seem to entertain views widely divergent as to the economy and efficiency of the machines.

The fuels, either fluid or gaseous, are certainly satisfactory, and the difficulties must be in the burners, which to me seems undoubtedly true. Among the gas burning injectors the Fletcher stands beyond all for popularity, as shown by the number employed. Yet the burner furnished is in efficiency far below that of the table blowpipe of either the Bunsen or the Buffalo Dental Company's best pattern; notably inferior to the "automatic" blowpipes in proportion to the fuel used.

One of the most frequently seen small furnaces is the upright blowpipe, which has the so-called Lewis support for the furnace. This is intended to hold a small furnace containing a Plattner crucible of clay, and, according to the statement of the makers, will fuse a gramme of iron filings in a very few minutes. I do not say it cannot be done; but neither I nor a number of others, who I know have made the attempt, have ever succeeded in such fusion, although the oxidization of the iron goes on unremittingly. Long before the iron could by any chance heat to fusion it is "burned."

The makers of this last kindly made for me a fitting to rest on the same support for fusions in porcelain crucibles, which was so exactly to my taste that I have wondered that they never duplicated it or put it in their catalogue.

Sometime after this experiment I obtained one of their "Automaton" blowpipes, and found in it the solution of a long-felt want. This blowpipe is the most efficient machine for obtaining high temperatures with hydrocarbon gases that I have yet met with.

This automaton blowpipe is not a blast Bunsen, but, on the contrary, approaches very nearly indeed to its name. With a sufficiently large bellows an enormous heat can be produced, if the supply of fuel is sufficient.

The chief difference between it and an ordinary blast Bunsen is to be found in the method of mixture of the air and gas. The flame without the blast is not a Bunsen flame, but a luminous one, and when the blast is turned into it a "pyrocone," which answers seriatim to the items of the classic description, is produced.

I have used it with satisfaction for all manner of blowpipe work, and while it by no means takes the place of the mouth blowpipe, it fills a place, or rather places, all its own. One of these is the heating of crucibles in a miniature furnace. With it, in a furnace constructed for the purpose from asbestos plaster, I have succeeded in heating a porcelain crucible until it showed signs of incipient softening.

Using this burner as a means to an end, I have used illuminating gas, water gas (carbureted and fuel), producer gas, gasoline air gas, and the vapor of cymogene and rhigoline, and last, but not least, acetylene and sulphuric ether.

Of this series I think gasoline air gas of 16 per cent. the least satisfactory; on the other hand, gasoline air gas of 22 4 per cent. to 28 per cent. does better than well. Illuminating gas (Brooklyn) and fuel gas (Chicago) give very satisfactory results, considering the excessive amount of air which is apt to be used from the diminished pressure of both as compared to the air supply.

Gasoline air gas, made by the ordinary carbureters, has never pleased me; either, notwithstanding years of off and on trying, I have never learned the manipulation, or there is a wrong somewhere else.

The vapor of the "petroleum ethers" was obtained by heating the fluid until it had a very perceptible tension and filling a gasholder surrounded by hot water. The water surrounding the gasogene and the holder was intended to be boiling hot, although it was probably less than this. It being understood that the vapor was air free until it left the burner, such a procedure was perfectly safe. Gasoline treated in the same way is a magnificent fuel.

While acetylene is much easier to manipulate than the vapor of gasoline or the petroleum ethers, it is not a better fuel; but its convenience is far greater. The whole group behave so much alike that a full description of the action of acetylene may be taken as typical. Indeed,

when I learned how to use the gas properly—and it took some time, for it is not a job to be done at the first trying—I ceased to use the vapors, finding in the gas a substitute which has been very satisfactory. Still I am not sure that for many uses it is so good as common illuminating gas; on the other hand, certain manipulations are possible with it which do not seem to be within the reach of illuminating gas and air. This is probably due to the peculiar rapidity of diffusion joined with the exceedingly reductive action. Unlike the gasoline air gas the flame is always a reducing one. This peculiarity is maintained to a very surprising degree. While the outer envelope will be as purely acid a flame as any, the blowpipe mouth device can be made to make, and the tip (which Ross sees fit to call the "peroxidizing pyrocone"), will develop to an extreme, the interior of the flame will still retain its reducing power, in this respect exactly resembling the flame which I have described in this JOURNAL as being the characteristic phenomenon when the Auer burner is used as a laboratory tool in place of the ordinary Bunsen.

With gasoline or other vapor, as with acetylene, but with no other gas, the beautiful reductions on the plaster slabs can be made with a table blowpipe as readily as with the mouth.

I do not see any gain in using acetylene over the illuminating gas for any other purpose in the uses of the laboratory, except the blowpipe. There is no form of Bunsen burner yet in vogue in which it can be used, and the use of it for simple boiling or comparatively low temperatures offers no special advantage, and no special disadvantage; still its superiority in the special use indicated should not be forgotten.

For heating larger furnaces than those of blowpipe size none of the gaseous fuels compares with the liquid ones. Nor, so far as my experiments go, is "greased air," by which phrase a New York chemist described the air and hydrocarbon vapor mixture from the carbureters, worthy of even the third place.

Injector furnaces are the proper things, and the decision and choice between an apparatus burning kerosene and one burning gasoline must rest on individual needs. For my part, I much prefer the heavier oil. It is perhaps less easily used at the beginning of the process, but after five minutes there is a decided advantage in its favor.

I do not think, however, that a bellows is a suitable method of maintaining pressure, but much rather would employ a drum, even of a comparatively small size. A drum containing a single cubic foot at the usual tension when raised to 10 atmospheres will work for a long time unmolested, and the pumps now easily and cheaply obtained give this pressure in a few minutes.

At this point also I wish to record my choice in burners. There are at least two in the market which are modified Bunsens in principle. The oil is sprayed through a tube in which it mixes with the air, and at the end of which it is supposed to fire. Far better is the simple apparatus in which the oil driven out in a fine stream under pressure strikes a lip and is transformed into a thin sheet, which is broken into the finest imaginable spray by a stream of air under tremendous, by comparison to its amount, velocity, and thrown like the impalpable drops of a good atomizer directly into the firebox. This is almost noiseless, gives a much more intense heat, and as the lip is never even warm, never lights back.

Without making invidious comparisons it is my conviction that the gasoline burner coming from Chicago is out and away the best gasoline burner made; but, for a kerosene burner, the New York pattern has no equal among laboratory appliances for heating any furnace hearth, crucible or muffle, always supposing the furnace is large enough to justify its use.

If the furnace is less than this, then some form of automaton blowpipe, in which the gas and air do not mix, fed by either acetylene or gasoline vapor without any preliminary dilution, is the best of tools we have. Unfortunately, a species of brazen elephantiasis seems to infect them all, and while from certain manufacturers small burners, equal in power to the largest ones, can be obtained, the impression seems to exist in the minds of many makers that size is a *sine qua non* of usefulness, when, in fact, it is often a hindrance.

Passing beyond the reach of the hydrocarbon flames, at temperatures about that of melting iron, the user of furnaces comes within the enchanter's realm of the electrician.

Within a short period a number of electrical furnaces have been made which would give temperatures at which iron evaporates and lead has distinct tension. Moissan's furnace has been on exhibition in New York city since some year or more ago, but so far as I can ascertain, those who have seen it have copied rather than purchased it. Efficient as it is in some ways, it is without any proper means of regulation and control. Two other forms are either now in process of development, or are really finished preparatory for the market, which will give temperatures limited only by the resistance of the body of the furnace to heat.

In both it is intended that the arc shall be multiplex and the electrodes be beyond the reach of the air.

In the muffle furnace it is believed a range of temperatures from that of 60° C. to the melting point of magnesium oxide will be possible; that is, if this melting point is below the temperature of gaseous carbon. The other (a crucible furnace) is intended for crucibles of the same material. The machines have not yet been patented, nor, in fact, quite perfected; but enough has been done to show that the mechanism of control is a complete success. The primary electrodes from which the arc is discharged into the filling of the furnace feed both ways, and the regulation has been satisfactory in all experiments made. The difficulty so far has been to find a medium sufficiently resisting to the awful heat.

Truly, the temperature range of electric currents for our experiments is wide enough, from a temperature within almost measurable distance of the absolute zero on one side to the temperature of a part of the sun's atmosphere a million of miles or so beyond the part our telescopes tell us of on the other.

In the student world electric heat has been employed to quite an extent, and without it much which has come to light would still be in the dark unknown.

Taking it all in all it does seem as if our means of obtaining and maintaining high temperatures, for which processes I used the word "securing," were ample, and that if the many pebbles of invention which have been scattered in New York were picked up and carefully examined by a competent hand some might be found to be gems.

There are many men interested in such inquiries. It is to be hoped that some one, with means withal to do and the will to do what means permit, will some day have the chance to take the walks I have taken among the workmen and find an interest for his patience and his purse.

Experiences with Regenerative Settings.

[A paper read by MR. FRANK PRENTICE (Ipswich, England) before the last meeting of the Eastern Counties Gas Managers' Association.]

The settings referred to in this paper are seven sets of mines, 21-inch by 15½-inch through ⬭ retorts, each set heated by one furnace. The regenerators are formed by spaces on either side of the furnace 4 feet by 1 foot 6 inches, divided by perpendicular tiles into three parts, the waste gases descending straight down the center one, through perforated tiles, being merely baffled on their way. The secondary air supplies ascend in two streams backwards and forwards four times on either side of the center passage, and unite in a final chamber before passing actually into the combustion chamber. There are four regenerators, one at either corner of the setting, and four combustion chambers. These latter are 8½ inches wide. In each of these are five exits for secondary air, and five for producer gas; these being exactly opposite one another, and of similar size. From front to back they run 6 inches, 5 inches, 3½ inches, 2½ inches and 1½ inches, and are all 1½ inches in depth.

Fires were started in four of these beds in September, 1894, and considerable caution was used in getting up the heats; so much so, that a full month passed ere any attempt was made to carbonize coal. When we did commence, only 6-hour work was attempted; and with Newcastle coal, and 2¼ cwt. charges, 11,000 cubic feet of gas per ton was produced—the make per mouthpiece coming out at 6,400 cubic feet per 24 hours. At this time the all-important fuel account was 17.5 pounds of coke per 100 pounds of coal carbonized. After a brief period, we adopted the usual 5-hour charges. The make of gas per ton and the fuel account remained about the same; but the make per mouthpiece rose to a maximum of 7,652 cubic feet per 24 hours.

After a few weeks, the heats began to fall, and a careful examination revealed the fact that parts of the settings had melted, and slowly run down, covering, as with a curtain, the producer gas exits. From this time, constant work was entailed in one or other of the beds, punching through this curtain and so keeping the exits open. As this was at Christmas, 1894–95, when, owing to outside conditions, everything inside needed to be at its best, considerable anxiety was experienced. Everything suffered; and only wretched results were obtained. As soon as possible the sets were let down, and the producer gas outlets enlarged to their original size, by cutting away the furnace arch, and doing the work from the inside. The outlets were now lined with Ewell bricks, and the slopes from the furnace to the combustion

chamber were made steeper. In the August following (1895), these beds were started afresh, and worked during the winter, in addition to three fresh beds, which had been built in during the summer months. The winter was hardly on us when troubles began to thicken. To regulate the heats evenly seemed impossible. The bottoms, especially the center one, got white hot, while the tops were not hot enough; and the whole trouble with the exit gas ports showed itself in a minor degree. Many of the hydraulic mains pitched right up and had to be thoroughly cleaned, one side at a time; all the gas passing up the opposite side during the operation. Many schemes were tried. One was to keep water running on to the hydraulic mains, another to run water down the ascension pipes, while a third, which gave us partial relief, was to work each tier of retorts for varying periods. Under this arrangement, the center bottoms before referred to, were charged as often as 8 times in 24 hours. As a last resource the center bottom was discarded, and backs inserted in the rest. These measures to a large extent ended our troubles. But they were retrogade steps, and we determined on further experiments.

When the summer of 1896 came round, the first four beds, which had done 430 days' work, were reset with 9's on a somewhat different plan, and the combustion chamber built entirely of Ewell bricks. When the time came to light them up we again adopted 6-hour work as a start, and produced 7,000 cubic feet of gas per mouthpiece. As soon as we reverted to 5-hour work, we found it well nigh impossible to keep up the heats; and an examination of draughts discovered the fact that our chimney only gave us 2½-10ths pull. To heighten the chimney was the next thing, and this was done to the extent of 20 feet—making its total height 72.6 feet. The draught rose to 4½-10ths, and we found the whole work more under control. Innumerable experiments have been made on the draughts at various points, and we find that the best results are obtained when there is a slight pressure in the combustion chamber, a ½-10th at the top of the setting, 1½-10ths under the last retort, and 2½-10ths in the last flue. There is no doubt, when everything is new and absolutely clear, such settings will work at a less pull than 4½-10ths; but without a fair margin to allow for partial choking, trouble is bound to come, and that probably at the most inconvenient time. During the winter we again had to abandon the center bottom, and insert backs; and this we did before difficulties accumulated too much.

These sets are still at work. They have done 400 days and seem as good as ever. Determined to retain the ninth retort, we now have three settings, with the center bottom inserted, all of them at work: and the local heating has been got rid of by the insertion of a brick-on-edge wall from the back to front of the combustion chamber, separating the secondary air supplies from the producer gases until they have reached a point higher up in the setting, and above the bottom middle retort.[1]

On relighting a set, a most careful examination of the regenerators has always been found necessary. It is generally faulty, and short circulating is taking place. An easy and certain method of deciding this point is to close all secondary air inlets and open the dampers as wide as possible. The producer gas gets drawn back through the secondary air inlets in the combustion chamber; and, owing to the great draught, streams visibly through any crack or hole, however small, into the waste gas passages of the regenerator, which, of course, must be partially opened for purposes of observation.

A certain amount of trouble has been experienced by the passages round the retorts becoming more or less choked; uneven heating being produced. We now insert a steam pipe, with a right-angled nozzle on the end, connected with a steam hose. A few minutes suffice to thoroughly clean out a whole setting; and this without the heat being sensibly diminished, or damage done to the setting.

A most important point is the clinkering doors. These must be absolutely tight. Experience has shown that it is possible to completely close the primary air inlets, without reducing the heat of a set, owing to the leaky condition of the doors and surrounding brickwork. While referring to furnaces, it may be stated that the operation of clinkering has been generally performed once every 48 hours.

Glancing back through the record of this period, the question suggests itself, What gain do regenerative settings give over similar settings worked on the direct firing principle? The average of a large number of tests puts the fuel account at 16.6 pounds per 100 pounds of coal carbonized. I am aware this is a high figure, if the published statements as to what the fuel account should be are to be taken as a standard. The temperature of the main flue is, and has been, all but black—probably, under 1,000° F.; at any rate, not red enough to see more than a yard or two into it. This fact I take to be a good evidence that the combustion has been fairly perfect; and it strengthens considerably the preceding figure. There is no doubt that some saving in fuel is effected, and that the life of the retorts is extended by this system; but, on the other side, there is the heavy item of initial expenditure.

1. The author here observed that they had done a little too much in connection with this question of the center bottom retort being the hottest; it was now not hot enough. The walls here referred to would have to be lowered some 4 inches, and then he thought they would get an even heat throughout the settings. When he wrote the paper, he had not arrived at this conclusion.

Discussion.

The President remarked that the members were much indebted to Mr. Prentice for his paper. It was rarely they had a gentleman bold enough to chronicle his partial failures before a critical audience such as that. He, therefore, thought the author deserved their hearty thanks. He (the President) was, of course, intimately acquainted with the whole of the troubles Mr. Prentice had gone through, and had often sympathized with him in the difficulties under which he labored.

Mr. R. G. Shadbolt (Grantham) said this was the kind of paper that was of the greatest value to an Association such as theirs. There seemed to have been a turn in the tide so far as technical papers were concerned; for, whereas previously they used to bring forward their successes and hide their failures, they seemed to be going in the other direction now, and brought to notice their failures as well as their successes. They had had examples of this during the present year, and it was a good sign, and one that was calculated to help them in preparing papers. The first question which occurred to him was only a small one, and there might be a local reason for it. It was this: Why was the retort section 21 inches by 15½ inches? They were so used to going an inch at a time that the ½ inch seemed rather curious. The next point was the width of the combustion chamber. He rather thought the excessively narrow combustion chamber, added to the fact that, in the commencement of the experiment, the producer gas exits and the secondary air nostrils were brought into immediate contact, was responsible for a great deal of the melting and a large part of the difficulties originally met with. He did not agree that the coke question was the all important one. In these days a few pounds of coke mattered very little compared with other features which were peculiar to regenerative settings. It was interesting to note from time to time the first experience of those who adopted the regenerative system of firing. Generally they found the retorts melted down, and an irregular heating of the settings, unless a setting was adopted that had been well tried and proved by lengthened experience. One thing that presented itself to his mind was that the extra ninth retort was scarcely worth the trouble it involved. Unless the works were large, better results would be obtained by discarding the ninth retort, and giving the additional room to the combustion chamber, than by trying to cram too much into the space. He thought this had brought about some of the difficulties which Mr. Prentice had so ably combated. There was one other danger he had noticed in works in various parts of the country; and that was the danger of converting the producers into huge, direct fires. There was a little indication of this in the paper, where Mr. Prentice said that it was possible to close the primary air supply, and yet kept the producer going. He (Mr. Shadbolt) thought there was danger in allowing too much primary air to be admitted to the producer, and so make it a direct fire instead of a producer; and it permitted too much grit to get into the combustion flues. He ventured to assert that Mr. Prentice had not yet reached finality in this matter; and, when he had solved the various problems that faced him, he would find that he had been amply repaid for the trouble he had taken.

Mr. W. R. Chester (Nottingham) thought with the President that Mr. Prentice was to be complimented on the courage he had shown in bringing forward a somewhat long and melancholy list of failures in connection with regenerative furnaces. Every one of Mr. Prentice's experiences had been met with before by those who had handled a regenerative furnace, and every one of them had had to be combated, and to a very large extent had been entirely got rid of. There was no necessity now for a gas works to begin to experiment with regenerative furnaces, because there were many types in this country; and anybody who introduced them had only to avail himself of past experience to insure success at the beginning. He noticed throughout the paper that the difficulties and troubles which had come in with the introduction of regenerative furnaces had created an impression in the mind of the author of the paper that "the game was scarcely worth the candle." If such an impression as this were to go abroad among those who had not adopted regenerative furnaces, he thought it would be detrimental to the interests of the gas industry, because there was no portion of gas apparatus in which there were greater capabilities of earning profit

than in the retort settings; and he (Mr. Chester) had come to the conclusion, after considerable experience, that anybody might avail himself of a sum ranging from 25 cents to 37½ cents per ton of coal carbonized by substituting regenerative furnaces for ordinary direct fired settings. This saving was made in three or four directions. In the first place, it was made up by the saving in fuel, by enabling a larger quantity of coke to be sold to the extent of 3 or 4 cwt., by the diminution in the amount of work necessary in attending to the fires, by the very large reduction in the cost of repairs, by the increased output on the same area of ground, and by the less capital cost per ton of coal carbonized during the lifetime of the settings. All these advantages came into operation where a successful system of regenerative furnaces was introduced. He noticed that among Mr. Prentice's experiences he had had the running down and melting of material. This was one of the very earliest experiences that manifested itself in connection with regenerative furnaces. It was so entirely got over by selecting the right kind of material, and by putting it in the right position, that they could get a durability and existence three or four times as much as the durability which Mr. Prentice had found in the case of his retorts. The production of 6,400 cubic feet of gas per day, 17 pounds of fuel per ton of coal carbonized, the arrangement of the center bottom retort, and the durability of 400 days were all results which would scarcely be considered satisfactory in the case of a good class of ordinary direct fired setting. While Mr. Prentice gained experience in connection with this matter, he (Mr. Chester) feared he had done so at considerable cost. The difficulties were only eliminated by the careful watching of one setting after another, so that they could be guarded against in reconstruction; but as settings ran for a long time, the opportunity of reconstructing did not come frequently enough in many moderate sized works to enable the manager to get the full benefit of his experience. It was only in the case of large works where reconstruction occurred frequently that the weak points in connection with regenerative firing could be overcome; and he thought that engineers who were contemplating the introduction of regenerative firing ought first to make careful inquiries as to what were the possibilities with some of the best systems in operation. As to Mr. Prentice's reference to having obtained a fairly perfect combustion in his main flue, he (Mr. Chester) thought his combustion had been too good in all probability. The short circuiting in the regenerator flues had affected the combustion. It had been too complete, and if Mr. Prentice were to analyze the exit gases going away in the chimney, he would find an enormous excess of air among them, and, of course, this had a tendency to lower his heats and his results. Successful working of regenerative furnaces could only be realized by making careful analysis of the gas in the exit flues, so as to limit the quantity of air to the minimum, and so as to insure that no more air was allowed to pass into the setting than was absolutely necessary for complete combustion.

Mr. W. D. Child (Romford) observed that the few years' experience he had had in the working of regenerative furnaces had led him to think that too much attention was given to the question of the saving of fuel. With the very low price of coke and the difficulty they had in selling it, he did not think that should be the primary object. Mr. Chester had named various advantages which came far before the saving in coke—such as the saving of labor, and the wear and tear of the retorts. By working the settings at high heats, they would get a large yield per ton of coal; but if they were content to work with the heats to which they were accustomed in firing, they might expect the retorts would last a great length of time. He had worked a setting of retorts 570 days without altering them at all. There were many advantages in running retorts over a long firing, without dropping, by keeping to a moderate heat that would yield 10,600 or 10,700 cubic feet of gas from Durham coal. He was then able, by repairing at a cost of about $20 or $25, to run the setting another 300 days. If gas managers would be content with the saving in labor and the same production per ton of coal as in the ordinary settings, they would obtain great advantage from regenerative firing. He thought the question of regeneration could be overdone; and he said so in a paper he read at Yarmouth some three years ago He was content with one simple line of flues to obtain all the regeneration he required. In this way they might construct a setting, with little danger of short circuiting in the flues, and also of waste.

Mr. J. E. Buckle (Woodbridge) remarked that the author stated that many of the hydraulic mains pitched right up, and had to be thoroughly cleaned. He was curious as to how these were cleaned while the retorts were in use.

The President—They were through retorts.

Mr. A. Graham (Mansfield) inquired the area of the chimney.

Mr. H. Wimhurst (Sleaford) said his experience of regenerative settings had been one of unbounded satisfaction, and he had not had the difficulties described by Mr. Prentice. Owing to the lapse of time, the settings were on a more improved principle, and they had only beds of 6's. By doing away with the center retort, a larger combustion chamber was obtained, and one could work in a much easier manner. As to the fuel account, Mr. Prentice mentioned 16 6 lbs. per 100 lbs. of coal carbonized. In his (Mr. Wimhurst's) case, it was between 12 and 13 lbs. Their total coke sales last year were 10 cwt. per ton of coal carbonized. Neither he nor his men would like to go back to direct firing. The regenerative settings worked much easier, and the men had only to clinker twice a week.

Mr. Prentice, in replying, said he did not know why the retorts were of the size named. It was the size they had used for many years, and, therefore, they continued to keep to it. Mr. Shadbolt had suggested that perhaps he (Mr. Prentice) had too much primary air. If he had, he did not think the flues would be so dull. It was also suggested that the combustion chamber was very narrow. The retorts were in sets of 9's, and 10 foot 3 inch centers through the arches; one could not get any more space where they were that size. As to the melting down being due to the chambers being too small, he did not think that was the case, because since they had renewed the bricks with Ewell bricks, there had been nothing of that sort. They had tried combustion chambers giving 3 feet clear; but they did not find any material improvement. When they had the melting down, only ordinary common firebricks were used; and he did not think they would stand the heat of the combustion chambers. The exit ports were still opposite one another, and now they had no trouble in that way. Mr. Chester said there was no occasion for anyone experimenting on these things. In fairness to themselves, he ought to say that they did not just put up something that they thought would do; but they adopted what they considered would be an efficient setting. The settings were not put in by the Company; and the difficulties were not due to them. The exit gases had been analyzed most carefully, and he had never found an excess of air. Mr. Child thought the saving of labor with regenerative settings was very great, but their experience at Ipswich did not agree with this. They had just as many men. They had less firing, and one man did more fires than he did under the old system. But the spare man was found to be necessary for dealing with the larger quantity of coke that was produced, and the distance it had to be wheeled out into the yard. One gentleman wanted to know how they cleaned the hydraulic mains while the settings were in use. They shut the valve off the main, removed the bridge pipes and blocked the ascension pipes on the side they had to deal with. They could then take off the top of the main, open the large plates and cocks they had underneath, and so clean it out—working the whole of the retorts from one set of pipes, and through the hydraulic main on the other side. As to the chimney, it was 4 feet 6 inches by 2 feet, and 76 feet high, with 4½-inch draught, and before they lengthened it they had only a 2½-inch draught. As to the fuel account, they had made desperate efforts to get it down, but had not been successful. As to clinkering, they used seaborne coal, and found that 48 hours was the longest they could comfortably run without clinkering.

The President remarked that he was not at all satisfied with 10 cwt. of coke sold per ton of coal carbonized. They had coke firing on the direct system, and were able to sell more than 10 cwt. of coke per ton of coal. There might, however, be other collateral advantages in regenerative firing. They had looked for something better, and were guaranteed something better; but they had not realized it.

Electricity versus Shafting in the Machine Shop.

By Mr. Chas. H. Benjamin, Cleveland, O

The trend of the discussion on a paper entitled "Friction Horse Power in Factories," presented at the December meeting of the Society, has suggested the presentation of this paper.

It seemed to be the opinion of many of the members who took part in that discussion, that the best solution of the problem was to "take the bull by the horns," and throw him out of the arena altogether; in other words, to displace shafting and belts by electric transmission rather than to try to improve their efficiency. That in many cases this is the true solution can scarcely be doubted; but it seems to the writer that there are considerations of more importance than mere economy of transmission.

In order to put this in concrete form, 12 establishments mentioned in the previous paper have been selected, the numbers from 1 to 6 inclusive representing establishments using heavy machinery, and the numbers from 7 to 12 representing light machinery establishments.

In Table I. the data are taken from the preceding paper, while the results in Table II. are calculated.

The cost of the shafting in column 1 of Table II. includes the cost of probable hangers, couplings and pulleys, and is based on the actual price of similar shafting in a modern shop, the cost ranging from $2 to $6 per linear foot.

The cost of the belting assumes the belts to have been from 30 feet to 50 feet long, and of single leather, and varies from $6 to $27 per belt for the widths given.

It is not claimed that the figures given in this column represent the exact cost of shafting and belting, but they show what the cost might well be in such establishments.

In estimating the cost of generators and motors for these same shops, it is assumed that a generator will be required having a power 50 per cent. greater than the net power used by the machines when the shop is running at full capacity, and that the aggregate power of the motors should be double this. It is further assumed that the motor unit will be from 5 to 10-horse power in the shops doing heavy work, and not less than 2-horse power in the shops doing light work. The cost of electric motors may be roughly classified as follows:

Horse power of motor....	2	3	5	10	20	40	50	65	75
Cost in dollars per horse power.....	65	60	45	35	25	20	17	16	15

The figures in column 2 of Table II. thus show what might reasonably be expected as to the cost of generators and motors for each establishment. No account has been made in the one case of the cost of countershafts and secondary belting, nor in the other of conductors, switches, and such countershafts as might be used, one omission being allowed to offset the other.

Column 3 shows the differences between the values in the two preceding columns, the + sign indicating greater first cost for electricity, and the — sign greater first cost for shafting transmission. It will be noticed that in general the electrical transmission has the greater first cost, but in establishments where the amount of shafting is out of all proportion to the useful work done, electricity has the advantage even here. (See shop No. 4.) In shops like Nos. 10 and 12, the machinery is compactly arranged, and the cost of shafting relatively light.

If there is any unfairness in the above figures, it is in over-estimating the electrical cost, since the writer desires to be conservative.

Table I.

No.	1. Total Line Shaft. Feet.	2. Diameter of Line Shafts. Inches.	3. No. of Belts.	4. Average Width of Belts.	5. No. of Machines.	6. No. of Men.	7. Total Horse Power.	8. H.P. to Drive Machines.	9. H.P. to Drive Shafting.	10. Useful H.P. per Machine.
1	1,130	2½ 0 2¾ / 4 0 6	89	4	..	..	400	243	157	
2	580	3 0 3½	28	6	18	78	74	17	57	
3	530	2½ 0 3	53	5½	43	152	38.6	13.3	25.3	.310
4	1,460	2½ 3 4	92	4½	69	80	59.2	11.3	47.9	.164
5	1,120	3	141	4	68	300	112	48	64	.707
6	1,065	2 3 4	192	4	123	225	168	77	91	.627
7	748	1½ 0 1¾ / 2 0 3	217	3	250	200	40.4	19.7	20.7	.790
8	500	2 0 3	335	3	313	226	74.3	34.3	40	.109
9	990	1¾ 0 2½	217	3	258	100	47.2	22.7	24.5	.881
10	2,490	2 0 6	521	3	454	400	190	82	108	.180
11	1,472	2 3 4	484	3	179	350	107	32.5	74.5	.181
12	1,800	2 0 2¼ / 2½ 0 3	486	3	428	320	241	127	114	.296

Table II.

No.	1. First Cost of Shafting and Belting.	2. First Cost of Generator and Motors.	3. Difference in First Cost.	4. H.P. Lost by Electric Transmis'n.	5. H.P. Lost by Shafting Transmis'n.	6. Net Saving by Electricity. H.P.	7. Saving in Dollars per Year.	8. Pay Roll per Year (Estimated).
1	.....	.....	.....	121	117	No gain.	.....	. . ..
2	3 650	7,150	+ 3,500	9	49	40	2,400	39,000
3	3,750	3,000	— 750	7	21	14	840	76,000
4	7,450	2,100	— 5.350	6	42	36	2,160	40,000
5	7,700	7,000	— 700	24	53	29	1,740	150,000
6	8,550	10,950	+ 2,400	39	74	35	2,100	112,000
7	2,700	4,300	+ 1,600	10	16	6	360	500,000
8	4,000	7,000	+ 3,000	17	32	15	900	113,000
9	4,000	5,000	+ 1,000	12	30	8	480	50,000
10	9,650	18,000	+ 8.350	41	89	48	2,880	200,000
11	7,550	7,000	— 550	16	64	48	2,880	175,000
12	8,400	25,000	+16,600	64	90	26	1,560	160,000

The figures in column 4 of Table 2 are derived from those in column 8 of Table I. by assuming a combined efficiency of two-thirds for generators and motors. The power lost in shafting transmission, column 5 of Table II., is obtained from column 9 of Table I., by deducting 10 per cent. of gross horse power for engine friction.

The net gain in horse power by using electric transmission is shown in column 6. Allowing $60 per horse power per year as the gross cost of power delivered, we obtain the results in column 7 for the saving in dollars per year.

Some one may object that these calculations are rough, and based on insufficient data. Even if we admit this, two facts can still be regarded as proven:

1. That the first cost of electrical machinery is usually greater than that of shafting and belting.

2. That the saving in power in most machinery establishments would pay for the additional cost of the electric plant in from one to five years.

Figures of this kind are about all that we can have to guide us at present. Statements from manufacturers are liable to be influenced by a personal bias one way or the other; and even where there is an opportunity for a fair comparison, the necessary data are usually lacking. Many cases could be cited where parties now using electricity claim an actual saving in coal burned of from 15 to 30 per cent.

In most establishments where electricity has been introduced, the transition has only been partial, the generator and motors being burdened with a load of shafting and belts, which prevent any saving in power from being effective. It is in new shops constructed with especial reference to electric transmission that we are to look for the best results in efficiency.

It is further to be remembered that the loss of power from shafting and belts is constant as long as the engine is running, whether one machine or a hundred be in operation, while the loss in electric transmission is a per cent. of the actual power used, and diminishes as the consumption of current diminishes. This is particularly important during times of business depression, when only a part of the plant is in operation. Some space has been devoted to considering the question of relative first cost and efficiency, since many arguments *pro.* and *con.* have hinged on these two points.

Electricity should not base its claims to recognition on either of these. In most cases there are far more important advantages to be considered. Referring again to Table II., it will be noticed that in column 8 are given the estimated pay rolls of the different establishments, allowing $500 per annum for each man employed. Notice how large these numbers appear in contrast with those we have been considering. A saving of from 2 to 5 per cent. in the pay roll is of more importance than any saving that is likely to be effected in the power plant.

The average useful horse power per man in the heavy machinery establishments before mentioned was 0.38-horse power, representing $22.80 per year on the usual estimate of $60 per horse power per year. If the services of the man are set at $500 a year, a low figure, the average cost of power is only 4½ per cent. of the cost of labor. In the light machinery establishments the average useful horse power per man was only $0.195, or $11.70 per year; being only 2½ per cent. of the labor cost.

In some shops the power cost represents only about 1 per cent. of the total cost of running. The question of the advantage of introducing electricity hinges not upon efficiency of transmission, but upon the effect on the output of product per man and per machine.

The different points to be considered in determining how electricity affects general economy of production may be classified as follows:

1 General arrangement of machinery to facilitate handling of work.

2. Clear head room for the use of electric cranes and small hoists.

3. Light and cleanliness.

4. Control of speed.

5. General flexibility of the system.

6. Use of electricity for other purposes than power.

1.—*General Arrangement.*—The ordinary machine shop of to-day, in its shape and size and in the general arrangement of its engines and machinery, is the slave of shafting transmission. The engine must be so located as to connect conveniently with the shafting; all the machines must be arranged in parallel lines, for the same reason; while the ceilings and posts must be designed with special reference to the demands of hangers and brackets. This has been so long the case, that perhaps we hardly realize the possibility of a change.

Machinery should be arranged with reference to the work it is to do, and not with reference to the power to be used; it should be so located on the floor of the shop as to be easily accessible for operation and attendance, and in such a way that the work may be readily handled and well lighted.

The whole shop should be planned with a view to handling the product with the least waste of time and labor, and electricity makes this possible. Large machines may be put in any position and at any angle, or, if need be, may be transported from place to place to accommodate the work.

The power plant may be located in the most favorable place for taking care of coal, water and ashes, and the power distributed to any building or buildings with but little loss.

2. *Clear Head Room.*—In all shops doing heavy work, the rapid and economical handling of the work is one of the most important factors in cheap production.

The electric crane is the most convenient and efficient carrier yet developed, and the absence of overhead shafting and belts in electric transmission makes its use possible over all the larger machines. The writer believes that small electric hoists will also take the place of hand hoists over smaller machines, until every machine in the shop can be reached in this way when desired.

This advantage of the electric system was what prompted its introduction into the Baldwin Locomotive Works, and the saving there has been notable. Formerly from 30 to 40 laborers were employed to handle the work in the wheel shop, while now only 8 or 10 are needed; formerly from 8 to 10 per cent. of the time of the skilled help was lost from delays in handling, but this loss has been reduced to less than 2 per cent. A saving of this kind is of more importance than any probable saving of coal.

3. *Light and Cleanliness.*—As another result of our long subjection to ordinary methods of conveying power, we have come to regard a machine shop as necessarily dark, a synonym for all that is black and dingy. A glance at the shops of some of our electrical establishments will convince any one that this is a mistake.

Shops like those of the Crocker-Wheeler Company, the Westinghouse Company, etc., have been called "show places;" but at least they show the way from darkness into light, and should receive credit for it. The belt is a dust carrier as well as a power carrier, and nothing can be kept clean in its vicinity. When we add to this the shadows cast by the shafts and belts themselves, we have a condition of things which tends to mistakes and poor work, and cannot be without a corresponding moral effect on the workman.

The writer saw, during the winter holidays, in one large establishment having the usual maze of countershafts and belts, an attempt to whitewash ceilings and walls, which was almost pathetic in its absurdity. The partial or entire absence of overhead belts, and the diffused light reflected from whitewashed ceilings and walls, will cause an improvement in both quantity and quality of output, which will prove a strong argument for electricity.

4. *Control of Speed.*—One of the minor advantages of direct connected motors on large machines is the possibility of easily and quickly adapting the speed of the machine to the kind of work being done. On large boring mills, and lathes especially when facing up work, this may be a factor of considerable importance in determining the cost of production.

5. *General Flexibility of the System.*—The ease with which the electric system of transmission may be adapted or extended is one of the strongest arguments in its favor. The extravagant consumption of power, as noted in the former paper, is probably due in most cases to a gradual extension of the shafting system by lengthening shafts beyond a reasonable limit, to the turning of corners with bevel gears, and to the use of turned and twisted belts, with their attendant evils in the way of guide pulleys.

Shops are usually planned with a view to present needs rather than future possibilities, and extensions are made at some disadvantage; but in the electrical shop this need cause no uneasiness. Whatever the location or the angular position of the new building, the only expense is that of new motors and a few hundred feet of wire.

If added experience shows the desirability of re-arranging any part of the original plant, there is nothing in the way. If at any time the mountain declines to go to Mahomet, Mahomet can easily be moved to the mountain, in the clutches of an electric crane.

6. *Other Uses of the Electric Current.*—If the right kind of an electric system be chosen, the same current can be used in a variety of ways which are just beginning to be appreciated. Besides the advantage of having arc and incandescent lamps without any additional expense for generators, the electric current may be used for welding, brazing, soldering, annealing and case hardening, and each and all of these operations may be effected locally on large machines without moving them from their positions. Some are inclined to look askance on electric motors, and to have doubts as to their duribility and freedom from accident. To the ordinary manufacturer and superintendent the electric motor is something that he does not fully understand, and, consequently, something to be distrusted.

An electric motor, if properly designed and constructed, requires no more care than any piece of machinery running at the same speed. The writer has had under his personal observation motors which have run for years whenever called on, have required less care than an ordinary loose pulley, and have cost almost nothing for repairs. Only lately the writer saw a railway motor driving a grinder for pulverizing furnace linings in an atmosphere so full of grit and dust that the operator had to keep his mouth and nose masked. The motor under a street car will convince the most superficial observer that there is nothing to be feared on this score. It is difficult to get reliable and precise data from actual examples, even from establishments where both kinds of transmission have been tried; but the almost universal testimony of such is that the new experiment is a success, that they would not go back to the old system, and that as rapidly as possible the electric system will be extended to all parts of the works.

The writer has recently visited several establishments in Cleveland where electricity has been introduced to a greater or less extent.

The works referred to as No. 5 in the preceding tables have, within the past year, been partially equipped. An electric plant has been put in, consisting of a 150-kilowatt generator, belted from the engine, and furnishing a direct current of 220 volts to various motors and to arc and incandescent lamps throughout the buildings. The motors are mostly shunt wound, self-regulating, and vary in capacity from 3 to 15 horse power. Owing to the arrangement of the buildings, it had formerly been necessary to run the line shafts at right angles and use quarter turn belts and guide pulleys. Some of the motors are now used at the angles to do away with the belts, but in general the shafting itself has not been disturbed, and consequently much of the loss due to shafting transmission remains.

In other instances independent motors are used to drive large machines or groups of machines. When there is much dust, as in the case of emery grinding, the ironclad motor is used. Although this can be called but a partial trial of the electric system, and has many of the disadvantages which could be avoided in a new installation, the experiment is so far a success, and will be extended as fast as practicable.

Through the courtesy of Mr. Bartol, a member of the Society, and superintendent for the Otis Steel Company, of Cleveland, the writer was permitted to inspect the works of the company, where a new electric plant is being installed. The company have used electricity to a limited extent for some time, and the present installation is intended to concentrate and unify the plant. As the works are distributed over an area of about 15 acres, and as the work is nearly all of a heavy nature, the wisdom of the change is apparent.

The central plant will contain a 165-kilowatt generator direct connected to a compound condensing engine, and a 75-kilowatt generator belted from a simple condensing engine, both generators furnishing current to the same circuit. Either or both of the generators can be used, according to the amount of current needed. A direct current of 220 volts will be used for both light and power, the arc lamps being in series of four, and the incandescent lamps in series of two. A central distributing tower is erected over the generator, from which overhead wires radiate to all parts of the works. Separate wires are run for the lighting system, in order that the lights may be controlled from the central station. Ammeters on each line show the relative amounts of current taken by each shop and by the lighting system. The switchboard is also provided with those very important safety valves, automatic circuit breakers. Mr. Bartol determined the amount of current which would be needed in the different shops by a method which is to be recommended to all who anticipate such a change.

Indicator cards were taken from the engines when driving the shafting, and when driving the different machines and the different shops, and from these cards the necessary capacity of motors and of generators could be quite accurately calculated.

The motors are either shunt or series wound, according to the use which is to be made of them, and vary in capacity from 5 to 30-horse power. The motors are in all cases belted to the machines or shafting and controlled by rheostats.

As a rule, no attempt has been made to displace shafting already in place, but the writer noticed two large roll turning lathes driven by independent motors, one of 5 and one 10-horse power. In the finishing room for steel castings, the machines are all arranged along the side of the room and driven by counter and line shafting attached to the wall, leaving clear headroom for the electric crane used in handling the work.

Electric cranes, both of the traveling and jib type, are in evidence throughout the works, and some portable machine tools are driven by independent motors. It is interesting to note that at this establishment the rival giants electricity, compressed air and hydraulic power are working side by side, each in his own proper sphere.

At the new shops of the Atlas Bolt and Screw Company, of Cleveland, a 2-phase electrical plant has lately been installed. The buildings in this case are located on three sides of a triangle, with the power house at one angle, a situation of things which almost precludes the use of shafting in the ordinary way. To the electric wires this makes no difference.

The machinery is mostly of the automatic type, arranged in groups, and running at a constant speed, a condition of things favorable to the polyphase system. A 60-horse power high speed engine is belted to a 45 kilowatt 2 phase generator and to a 15-kilowatt exciter. The exciter is made of this size in order to furnish a direct current for the lighting as well, the lamp system being thus entirely distinct from the power system. The use of the exciter is somewhat novel and interesting. Motors are scattered throughout the works wherever needed, in sizes varying from 5 to 20-horse power. They are in most cases hung from the ceiling at the same height as the shafting, so that the belts are horizontal. The motors are all of the induction type, and entirely destitute of commutators or brushes, so that they require no attention, except to keep the bearings oiled. The motors can all be started at once from the engine room, or each one separately by a switch.

No attempt has been made to do away with the line shafts and counters, as the nature of the machinery renders this impracticable, but the ability to run even remote sections of the shops independently of the remainder, as well as the entire absence of vertical belts through the floors, has been a sufficient reason for the adoption of this form of transmission.

General Conclusions.—When the shops of a manufacturing establishment are scattered over a considerable extent of territory, the installation of a central power plant having large and economical engines, and the distribution of the power to the different shops by wires, instead of by steam pipes, is a change always to be recommended, and that will soon pay for itself. When the establishment consists of one large building or compact group of buildings, a change to the electric system is to be recommended where heavy work is to be handled, especially if the machines are somewhat scattered, require considerable power, or are intermittent in their action. In such cases some of the shafting may be left in position, but the writer believes that if the more independent motors are used on machines requiring over 2-horse power the greater will be the economy.

In shops doing light work and having many small machines compactly arranged and in continuous operation, a change to the electric system would be expensive and of doubtful utility. See, for instance, shops 10 and 12 in tables.

In building a new shop the chances are better for electric installation, and any manufacturer who does not, under these circumstances, investigate the subject and consider carefully the question of using electricity, is making a great mistake.

The ideal arrangement for a shop handling heavy work is that of a building having one lofty center aisle lighted from above, and two side aisles of less dimensions lighted from the sides. Every square foot of floor space in the central aisle should be commanded by electric cranes. Here the larger tools will be located, each with special reference to convenience in handling work, and, as far as practicable, fitted with independent motors.

The smaller machines are located in the side aisles near the dividing line of columns, and may be driven in groups by short lines of shafting hung on the columns below the tracks of the travelling cranes, each line being driven by a separate motor. Units of about 5-horse power are large enough for this kind of work. Motors of 2, or possibly of 1-horse power are as small as can at present be economically used. The benches for hand work should be located at the side walls near the windows. Smaller cranes and electric hoists may command all the space in the side aisles. Some of the drills and shapers should be fitted with direct connected motors, and having eye bolts at the top by which they may be moved from place to place. In the power house the use of two generators, one large and one small, will often prove economical, the smaller one being used for night or overtime work.

Polyphase and Continuous Current Systems.—The writer, as a mechanical and not an electrical engineer, hesitates to say much on this delicate subject. However, it is a question which must be settled at the outset in deciding upon the arrangement of a shop. The great advantages of the polyphase or induction motors are in simplicity, their freedom from rubbing contacts, and the constancy of their speed; the great disadvantage, the fact that the speed cannot be regulated, since the motor must always be in phase with the generator. When electricity is to be applied simply to run line shafting and counters, and the speed of separate machines is to be controlled by the usual belts and gears, the polyphase system is entirely satisfactory.

On the other hand, when it is necessary to use independent and direct connected motors on cranes and on machine tools, prompt and economical speed control is an absolute necessity; and it is here that the continuous current machine has a great advantage. Without any prejudice, it is the earnest belief of the writer that the greatest advantages in electrical transmission are to come from the use of independent motors to the largest extent possible, and that the time will come when nearly every machine in the shop will have its own motor. Progress in this direction is slow, and the intermediate steps must be taken first; but when an electrician sneers at the use of direct connected motors *per se*, one cannot but suspect that it is only because he has not yet perfected a motor that will satisfy the requirements.

The principal difficulty in designing direct connected motors for machine tools has been that of getting slow speed without great weight and of securing proper speed variation without seriously impairing the efficiency. The multipolar machine has helped to solve the former difficulty. In regard to the latter problem it may be said that the speed of the motor has usually been changed by introducing resistance into the armature circuit, thereby causing a loss of power corresponding to the reduction of speed.

Lately motors have been constructed with so-called commutating fields. The motor in this case has several fields wound in separate coils, and when a change in speed is desired these fields may be cut out one after the other.

If desired, a combination of this system, with a resistance in the armature circuit may be used. The so called Leonard system, having several feed wires carrying currents of different voltages is, of course, somewhat expensive on account of the amount of copper used and the general complication of the system. It is, however, very encouraging to note the improvements which are constantly being made in the construction of slow-speed generators for direct connection.

It is better in a paper of this kind to avoid mention of any particuiar firms. Suffice it to say that there are at the present time at least two firms of established reputation who are ready to supply slow-speed motors suitable for direct connection to machine tools and capable of almost any degree of speed regulation. These motors can be run at from 100 to 200 revolutions per minute, and can be obtained in sizes of from 1 to 5 horse power, while the guaranteed efficiency is from 70 to 80 per cent. Until it shall be possible to do away with shafting and belts in situations where that is desirable, the problem is only partially solved. The steps thus far taken in the direction of electrical transmission, while encouraging, can only be regarded as the beginning of a more radical change.

It is the hope of the writer before another year to make some experiments in establishments which have introduced electrical transmission, and to show more conclusively than has been done in this paper the economic advantages of the newer system.

Frank's Hydrometric Tube.

Engineering says that in spite of the researches of Weisbach, Francis, Hansen, Lebros, Darcy, Bazin, Woltmann, Pitot, Amsler-Laffon, and others, the determination of the velocity of moving water is still a problem of considerable difficulty. In the elements of hydrodynamics which Castelli, a pupil of Gallileo's, published, in conjunction with Torricelli, about 1640, the following dictum is attributed to Galileo:

"I have found less difficulty in discovering the movements of celestial bodies, in spite of their astounding distances, than in determining the rate of flow of water under my very eyes." In a certain sense this remains true to the present day. The hydraulic engineer has to be satisfied with approximations which would hopelessly discredit any astronomer. The velocity of a current can be calculated from the quantity of overflow or the mass which passes through a certain section per unit of time; further, by means of floats or from the static or dynamic pressure. In all cases, however, we are confronted by the difficulty that the rate of flow amid stream on the surface is greater than near the banks or bottom. In a straight channel this gradual decrease of speed may be averaged at 17 per cent. In a river we have to take observations at different depths and different points across a section to arrive at anything like the average speed.

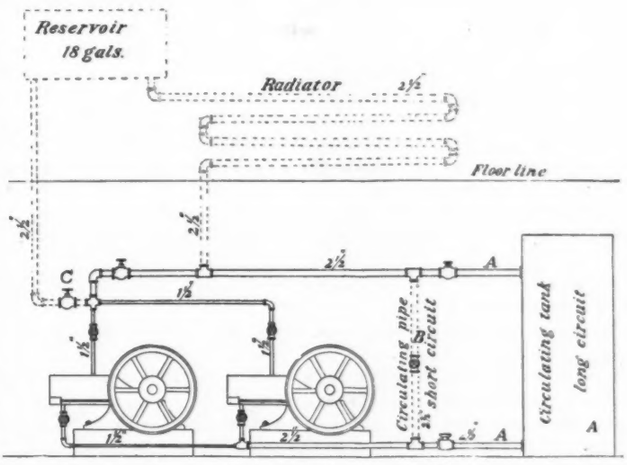
In this respect the hydrometric tube of A. Frank, constructed by G. Falter & Sohn, of Munich, constitutes an advance upon the two instruments, now largely employed on the Continent—Woltmann's vane, which revolves in the water, and Pitot's tube, improved by Amsler-Laffon, practically a tube bent to a right angle, in the vertical arm of which the water will rise to a higher level in accordance with the velocity of the water entering the horizontal arm. Frank finds at one observation the average rate corresponding to one ordinate.

The instrument consists of four parts—the tube R_1 perforated in a line and provided with a rudder by means of which it is placed so that the holes face the current; the tube R_2, sliding over R_1; the smaller tubes R_3 and R_4, with their rubber connections; and the manometer or pressure gauge. A small air pump is further required. The tube R_1 is fixed in the river bed, and R_2 adjusted by means of the screw S, so that its lower edge, with its stuffing box, is immersed about 3 or 4 inches. The water will rise in R_1, and also in the annular space between R_1 and R_2 with which R_3 communicates; in R_4, which is slotted at its lower part, the water will rise to the height of the river level. Both levels are, by manipulating the air pump, sucked up into the manometer, whose inner glass tube, communicating with R_2, contains an aluminum float which will oscillate with the hydrodynamic pressure, whilst the outer tube shows the river level. The cock above the manometer permits of adjusting the air pressure, lest the float should stick. The gauge must, of course, be absolutely airtight; the screws u and g permit of cleaning and exchanging the gauge. The ordinary gauge is suited for rates of flow varying between 0.1 to 2 meters (from 4 inches to 6.6 feet) per second. Special manometers on a tripod stand, and longer connecting rubber tubes, are required for higher velocities. The instrument has the advantages of direct reading apparatus, and is strong and simple, both in its construction and use. No time observations are needed. The tube can be fixed close to the bank, and observations can easily be made during tests of hydraulic motors. The instrument has been used for about three years, and a high degree of accuracy is said to have been obtained.

Gas Engine Water Heating System, Grand Rapids, Mich.

A gentleman prominent in the management of the Grand Rapids (Mich.) Gas Light Company, writing to us under date of the 22d of September, says that Mr. William Widdicomb, a resident of Grand Rapids and a prominent gas consumer, has successfully used the heated water from a gas engine water jacket to warm the corridor of his office building. He uses two 13 horse power gas engines to pump water for elevator service. The water jackets of these engines were cooled by the usual method of tank circulation, as shown by the continuous lines in the accompanying sketch. The system was extended, as shown by dotted lines, the hot water being carried, first, to a small reservoir at the highest point in the system, thence descending through a series of hot water radiators back to the basement.

The dotted pipe, B, was placed to secure a more direct circulation than was had through the tank, and suitable shut-offs were placed to change the course of the water through the short circuit, B, in cold weather, or the long circuit, A, in warmer weather, the circulation during the summer months, through reservoir and radiators, being entirely cut off by means of the valve, C.



Gas Engine Heating System, Widdicomb Building, Grand Rapids.

Mr. Widdicomb has also arranged to supply hot water for the barber shop, on the second floor of the building, by passing the gas engine exhaust pipe lengthwise through an ordinary 30-gallon kitchen circulating boiler, located in basement with engine. The heated water was carried up to shop by piping, ending with the usual tap. Water is thus constantly supplied at almost boiling point in the barber shop.

Rubber Substitutes.

The *India Rubber World* says that substitutes enter very largely into the compounding of rubber, because of certain distinct advantages which they possess, and which are not shared by coal tar or the simple mineral adulterants. They have not the vulcanizing effect of sulphur or the metallic oxides and sulphides. The chief value lies in cheapening the stock without disturbing its working qualities or impairing the texture, finish or weight of the manufactured product. Their after effect on the life of the goods is, however, another matter.

The term "rubber substitute" may be broadly considered as including any substance possessing characteristics similar to those of unvulcanized rubber, and adapted to displace it in compounding. Ordinary reclaimed rubber, as well as the sulphurized oils, is included in this definition.

The reclaimed rubber of commerce is obtained by steaming or devulcanizing old rubber waste, generally shoes, freed more or less perfectly from fiber. Having originally contained some real caoutchouc, it is generally considered rubber of low grade rather than rubber substitute. Since its introduction its use has rapidly extended, until it is now a very essential factor in the ordinary and cheap lines of goods, and its presence is not entirely unknown even in the highest grades. As a substitute, it ranks first in merit and general use; the annual output in this country alone reaching thousands of tons.

As a substitute it is most available in goods where color or extreme lightness are not essentials. Being chemically inert, that is, free from any oxidizing tendency, it can be compounded with rubber in all proportions without injury to the new stock.

The sulphurized oil substitutes constitute a class by themselves, and are distinguished as brown or white, although chemically they are essentially very similar. Any of the readily oxidizable, rejectable or drying oils combine freely, under proper conditions, with sulphur to form a more or less rubberlike mass. According to the selection of the oil and the mode of treatment, we get brown or white substitute. Such oils as linseed, rape, mustard and peanut are well adapted to make brown substitute. The process is a simple one, consisting in boiling any one of these oils or mixtures of them in any proportion with flowers of sulphur. The operation may be carried on over a fire or by steam in a jacketed kettle. The proportions are generally about 80 per cent. of oil and 20 per cent. of sulphur. The reaction is complete in three or four hours at the heat of 80 pounds of steam (325° F.) It is well to boil the oil out of doors or in a strong draught of air, to carry

off the noxious vapors. The mixture should be thoroughly stirred while cooking.

Mustard oil reacts quite promptly with sulphur, but gives a firmer product, and one that breaks rather shorter than that from the other oils named. It is best used in mixture with them. Linseed gives off the most disagreeable odor, and has no special advantage in point of quality of product.

The white variety of oil substitute is made by treating refined mustard, rape, castor or cocoanut oils separately, or in mixture with sulphur chloride either in the cold or with moderate heat.

The light porous variety may be made by mixing with the oils a small proportion of sodium bicarbonate, which under the influence of the sulphur chloride, generates gas in sufficient quantity to render the whole mass very spongy.

The operation should take place in an earthen or lead-lined vessel, and the sulphur chloride be added slowly and stirred briskly into the oil.

The proportion of sulphur chloride to oil should be about 1 to 8 and of soda to oil about 1 to 12.

When the chemical action is over, the product is allowed to dry for a couple of days before use.

A solid, amber colored substitute is made in the same way and proportions, omitting the sodium bicarbonate.

All operations involving the use of sulphur chloride should be conducted in a strong draught, and best in the open air, to avoid the evil effects of the vapors.

Chemically, the use of these sulphurized drying oils in rubber compounds is bad. They exert a marked influence in shortening the life of the goods, because by their active chemical nature they hasten the oxidation of the rubber present to the brittle resinous products which give evidence of their existence in the compound by its loss of elasticity, and by the hardening and cracking of the surface. There is little to be said for these oil substitutes from a chemical point of view. Their great practical value is entirely a matter of price, for they enable the manufacturer to cheapen the stock while maintaining the proper relative weight or specific gravity of the compound with reference to pure rubber.

The matter of specific gravity, or the ratio of the weight of any sub stance to that of an equal volume of some other substance taken as a standard, is a point of much importance. It governs the relation of pound price and piece price in rubber manufacture. Specific gravity and the percentage of ash in a rubber compound once gave an indication of the amount of rubber present, but since the extensive use of oil substitutes they have no value as specifications of quality.

The specific gravity of caoutchouc or pure unvulcanized rubber is 0.915. It will, therefore, float in water about like ice—that is, nearly submerged. The oil substitutes are slightly heavier; enough so to sink in water.

The Preservation of Iron in Building Structures.

By Mr. H. C. Standage, in *The Builder* (London).

Probably the greatest number of patents in connection with pigments are for paints to act as preservatives of iron. But although each patentee claims, and perhaps, firmly believes, that his specialty is better than any other product, nevertheless the perfect iron protective paint has yet to be formulated.

In the first place let us consider the nature of the iron used in structures. We shall then be better able to understand the chemical reactions that occur on the surface of the iron, whereby its corrosion is effected by the very paint that is laid over it to preserve it from atmospheric corrosion.

Iron, as we know, in constructors' work, whether wrought or cast, is essentially all metal, that is, it is free from adventitious bodies as far as the metallurgist can produce it. Steel is iron in which carbon has been made to commingle with its particles.

Now iron, whether wrought or cast, has a great affinity for oxygen, and if the iron is placed under suitable conditions the two bodies, iron and oxygen gas, will chemically unite and form oxide of iron. The brown or red "rust" on iron is an oxide of iron; there are many other oxides of iron, since oxygen unites with this metal in several proportions. Now most of these iron oxides are powdery substances; not a hard resistant body like the metal, but a soft powdery body that can be rubbed up between the fingers.

The "suitable" conditions under which oxygen unites with iron is when hydrogen is present in the form of moisture or water, the product of a union of hydrogen and oxygen gases. When you drop a little water on a piece of iron and leave it for some time, the liquid water disappears and a brown or red spot remains in its place. This spot of rust is an oxide of iron, and has been produced because the metal has exerted a greater elective affinity for the oxygen in the water than the hydrogen gas did, whence the oxygen and metal combine, allowing the hydrogen constituent of the water to escape into the air. Again, oxygen being a large constituent of the atmosphere, this element in moist air has a very large destructive influence on iron surfaces. If, however, the air be perfectly dry the oxygen will have no action whatever on the iron, but if ever so slight an amount of moisture be in the air, then the chemical union between the oxygen and the iron is at once set up, and when once this action is started it continues, whether the air be wet or dry, until all the metallic iron has become converted into oxide of iron, or "rust," as it is more commonly called. It is the object of all paints that are to act as preservatives to prevent this erosive action of humid air on iron. Iron preservative paints do this so long as they remain unchanged themselves by atmospheric action, but when once the paint is decomposed and the segregation of its parts commenced, then the rusting of the iron can also commence. But many of these so called iron protective paints are actually the first to start the conversion of the iron into oxide, in this way; linseed oil, which is used as a vehicle for binding together the particles of pigment forming the paint, possesses glycerine as a constituent, and this glycerine is liberated from the oil when the latter enters into chemical combination with the pigmentary matter ground up in it.

Now, glycerine is a body which will not combine with pigments to form a paint, and, moreover, it has a great power of absorbing water, consequently if a paint that is laid over an iron surface evolves glycerine during some period of its career, that glycerine whenever it reaches the metal will set up erosion, and thus start the conversion of the metallic iron into rust or oxide of iron. From this we see that although a paint may shield iron from the action of atmospheric agencies, yet it may begin the destruction of the metal itself. This is a point that is too often lost sight of by inventors and compounders of paints for iron surfaces. When we consider that on some of the iron bridges that have been erected during the present century, tens of tons of iron in the shape of rust have been removed, it will be seen that the time can be calculated when such bridges will no longer be able to support their own weight, for the solid metal will have been reduced so much by corrosion as to be a mere skeleton of its original self. Now it is the behavior of this glycerine in the paint which ought to be watched, because it is on the free, uncombined presence of this body or its combinations with other bodies that depend the preservative qualities of the paint.

It is generally conceded by architects, engineers and paint compounders that either red oxide of iron (as Venetian or Indian red), or red oxide of lead (as red lead) form the best protective paint, and they explain this protective action on the theory that these oxides, by themselves imbibing oxygen from the air to form higher oxides, so prevent the undesirable union of the oxygen and iron, and also because these oxides, when compoundeed with linseed oil, cause the latter body to be rapidly converted into tough insoluble linoxide which, while yet hard and elastic, is not chemically acted on by atmospheric agencies. This theory is not half the truth; the true reason for the above two metallic oxides being the best pigments for forming the base of an iron preservative paint is this: Red oxide of iron *combines* to a *great extent* with the glycerine which is eliminated from the linseed oil, but the red oxide of lead *completely* combines or absorbs this glycerine; the consequence of this partial and total absorption of the destructive agent, glycerine, by these pigments is that the erosive action that would be set up if the glycerine were free is prevented: in the case of the red oxide of iron partially, and in that of the red oxide of lead totally.

This, then, is the chief point that paint compounders should pay particular attention to, viz., to make sure that the components of the paint are such as will not allow any free glycerine in the paint to be present.

I will now ask my readers' close attention while explaining how this may be done. Before doing so I would point out that my researches on the subject do not bear out the theory most recently advanced, viz., that the beginning of corrosion is due to carbonic acid in the air, and that the thin film of carbonate of iron that is thus formed is acted on by oxygen in the moist air. In my researches I found that pure distilled water—*i. e.*, free from carbonic acid gas—corroded iron when placed in an atmosphere free from carbonic acid, also that iron, in the presence of carbonic acid gas in moist air, did not oxidize quicker than in moist air free from the presence of carbonic acid. I also found that iron filings would not ignite when projected into a jar containing a mixture

of oxygen and carbonic acid gases, whereas, when iron filings are projected into a jar of oxygen gas, the metal so rapidly unites with the oxygen as to ignite.

As already mentioned, there are several varieties of oxides of iron, but the typical one that should be used as a paint is the sesquioxide (represented by the chemical formula Fe^2O_3); this is the bright red oxide commercially known as Venetian red. But (and it is important to bear this in mind) the commercial Venetian red is not a pure article; that is, it does not consist solely of oxygen and iron, but lime and other bodies are present; these bodies are added by the pigment manufacturer during the calcination of the iron salt with red oxide. The native oxide that in any way approaches the above chemical composition does not contain perhaps more than 70 per cent. of oxide of iron, the remaining percentages consisting of alumina and silica. Such an oxide is better, however, as a paint than a pure oxide of iron, answering to the above chemical formula, because the silica and alumina give the pigment a certain amount of covering power and binding qualities when the pigment is ground up in linseed oil. Chemically pure sesquioxide of iron does not possess such a good covering power; in fact, the chemically pure oxide, when ground up in oil, would so "burn" the oil vehicle during the grinding as to partially decompose the oil.

Again, the artificially produced red oxide of iron called Venetian red is produced by calcining sulphate of iron mixed with sulphate of lime (gypsum) or baryta, usually the former. These bodies are used in the calcination to preserve the bright tint of the red oxide produced, but their employment is chiefly for increasing the weight of the product and thereby cheapening the cost of production. The presence of either of these two bodies, gypsum or baryta, in the paint, is detrimental to its preservative qualities. On the other hand, if sulphate of iron is calcined alone to form the red oxide, more often than not a different oxide than the one desired is obtained; and, likewise, there is generally present either free sulphur or the radicle sulphuric acid, because in calcining ferrous sulphate a very great and prolonged heat is required to completely expel all the SO_3 (the formula for ferrous sulphate is $FeSO_4$), which, when heated, has the SO_3 radicle expelled, leaving FeO —iron oxide—behind in the red powder; consequently, if any free acid or sulphur be in the red oxide, such a pigment, when ground up in the oil, will sooner or later cause mischievous decomposition to set up, whereby the protective qualities of the paint are considerably weakened. The theory underlying the use of sesquioxide of iron as a protective paint is this: The sesquioxide is the only oxide of iron which does not undergo incipient combustion (*i. e.*, does not change into a lower or a higher oxide, which all other oxides of this metal do), and also because this particular oxide does not set up decomposition in the oil in which it is ground, whence the oil vehicle dries or hardens into a tough impermeable skin that is protective against moisture and atmospheric influences, hence the paint formed with linseed oil and red oxide of iron dries and hardens very rapidly.

The theory of the non-activity of red oxide of iron is a very sound one, but the theorists who pin their faith to it have ignored one chief factor in such a paint, and that is the elimination of glycerine from the linseed oil, and the non-absorption of it by the pigment (the action of this glycerine on metallic iron has already been described). This glycerine is the secret and unsuspected foe, insidiously working destruction on the iron, although the coat of paint may be hard and dry on the exterior surface.

So far as the writer is aware, the presence of this glycerine in paint is not even suspected—much less known to be present—by compounders or inventors of paints for protecting iron surfaces.

Another important point that militates against the perfect preservative properties of red oxide of iron, as apart from metallic iron, is the very great difficulty of obtaining the oxide free from accidental or intentional impurities. As red oxide of iron does not absorb *all* the glycerine that is eliminated from the oil during the drying process of the latter, and as this glycerine is a good conveyer of oxygen to the oil, all the conditions most suitable for causing oxidation of the iron are inherently present in a paint of which red oxide of iron is the base. Hence we find that paints made from oxides of iron are *not* perfect protectors of iron surfaces.

[To be Concluded.]

Mr. Jas. W. Lane, formerly Superintendent of the Akron (O.) Gas Company, has accepted a responsible position under Superintendent Gerould, at the works of the Eastchester Gas Light Company, of Mount Vernon, N. Y.—one of the properties of the American Gas Company.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Stockton (Cal.) Gas and Electric Company the following officers were chosen: Directors, Oliver Eldridge, F. A. Hihn, Alfred T. Eastland, W. J. Dutton, W. E. Brown, G. C. Hyatt and H. E. Adams; President, Oliver Eldridge; Vice-President, F. A. Hihn; Secretary, A. T. Eastland.

The City Council of Corvallis, Oregon, has refused to grant a franchise for the operation of a gas plant in that place, application for which was made by Mr. J. H. Wilson.

The regular quarterly dividend of 1½ per cent. by the Toledo (Ohio) Gas Light and Coke Company is payable on demand.

Messrs. Walter Wood, Spencer Jennings, Stewart Wood, W. H. Felton and H. T. Powell, the Committee named by the bondholders of the Macon (Ga.) Gas Light and Water Company to formulate a plan for its financial rehabilitation, have virtually completed the scheme.

The contract for the public lighting of Louisville, Ky., for the ensuing five years, has been awarded to the Louisville Gas Company.

The roof of the new Spence Library, of the Union Theological Seminary, Richmond, Va., will be of fireproof construction. The trusses are to be of steel, and the covering of slate will be attached directly to metal supports. One end of the building is round, making a conical shaped roof, and at various points of the roof slope are placed dormers and skylights. The peculiarity of the construction makes the iron work very intricate in order that a pleasing architectural appearance may be secured. The contract for furnishing and erecting the steel work for the roof has been awarded to the Berlin Iron Bridge Company, of East Berlin, Conn.

Something over a fortnight ago the Welsbach Light Company began proceedings in the United States Court, Hartford, Conn., before Judge Shipman, against the Benedict & Burnham Manufacturing Company, of Waterbury, Conn., for alleged infringement of patents controlling certain stamped brass specialties used in connection with incandescent gas lamps. Judge Shipman, at the request of defendants, deferred the hearing, last Thursday having been set for the argument. We have not received any further advices over the subject. It might be added that the Judge issued an order restraining defendants from making deliveries of the specialties to any parties until further notice.

Rumor has it that the plant and franchises of the Nashville (Tenn.) Gas Light Company are about to change hands.

The Boston *Journal*, in reporting the results of the last annual meeting of the Brookline (Mass.) Gas Light Company, says that 19,768 shares out of 20,000 shares of stock were represented. The Treasurer's report showed that the total profits for the year amounted to $350,052. Interest and dividends for the year absorbed $323,746. Of the balance there was reserved for bad debts $20,000, and there was charged to sundry items, to depreciation, etc., $6,306, so that the profit and loss account shows the same debit balance, on June 30, 1897, as on the last day of the previous year, $303,595. The Directors chosen were: Robert Amory, F. W. Lawrence, Sydney Chase and Albert C. Burrage—the latter succeeds H. M. Whitney. The executive management chosen was: President, Dr. Robert Amory; Treasurer, Charles L. Crehore, vice Arthur Amory, resigned; Clerk, Charles D. Burrage.

The proprietors of the Cicero Gas Company, Oak Park district, Chicago, are preparing a new schedule of rates, which it is said will shortly become operative.

Last Monday the Massachusetts Board of Gas and Electric Light Commissioners promulgated a decision on the petition of the Selectmen of the town of Rockland, Mass., for a decree establishing lower rates for lighting the town by the Rockland and Abington Electric Light and Power Company. From 1891, until March 1, 1897, the Company had been furnishing electric lights for the town at the rate of $66 for arc lights and $14 for incandescent lights. Some time prior to the town meeting set for March last the Company sent a communication to the authorities stating that as the existing rates were unremunerative the service would not be renewed on the prevailing terms. The Company proposed to furnish a like service, but the prices were to be raised to $70 per annum for arc lights and $16 for incandescent lights. The authorities declined to accept the new rates, and the proposition was

finally referred to the Commissioners for adjudication. It should have been said also that the Company insisted on a 5-year contract. When the case was argued before the Board, in addition to speeches declaring that there was a sufficiency of profit to the Company at the old rates, it was said that all opposition had been stifled because the Company had virtually consolidated with the local electric railway company, which, prior to such consolidation, could have been depended on to bid for the public lighting. The Board, in passing on the question, stated that while it was undoubted that the interests of the two Companies had become identical, it was nevertheless true that such consolidation had worked no hardship to the interests of the town. The Board further reported that the rate offered provided no more than a moderate profit for the Company, and recommended that the rate be accepted by the authorities. No mention was made as to the term of the contract.

A RECENT issue of the Winnipeg *News*, of Winnipeg, Manitoba, has the following mention of the betterments to be made in the plant and in the business practice of the Manitoba Electric and Gas Light Company, some reference to which was made in our issue of last week: "Mr. James Stuart, Manager of the gas works, has made an announcement that will be received with no little satisfaction by the citizens of Winnipeg. He states that hereafter that the gross rate will be $2.50 per 1,000 cubic feet, with 10 per cent. off for prompt payment. The old rate was $3 per 1,000, with 10 per cent. off. Manager Stuart declares that this reduction is the outcome of the amalgamation which recently took place between the local street railway and lighting interests. It is the intention of the new Company to largely extend its gas business. In fact, a large force of men is at work putting down mains in new territory, the ultimate expenditure on this account being put at $25,000. A holder up to storing 300,000 cubic feet will also be constructed."

THE Act of the last Massachusetts Legislature requiring gasfitters to take out licenses, and to the specific supervision of gas fitters in Boston, went into effect the 1st inst. Under this Act, no person, firm, or corporation, can engage in or work at the trade of gas fitting in Boston, without having passed an examination and secured a license; and no building shall be piped or fitted for gas, or repairs made in the old fittings, or any fixtures placed before the Building Commissioners have issued a permit. Examinations of master gasfitters and journeymen are being held daily in the office of the Board of Health. The examining Board consists of Dr. Samuel H. Durgin, Chairman of the Board of Health; Building Commissioner, John S. Damrell and Mr. Chas. B. Gould.

RECENT contracts awarded to the proprietors of the Logan Iron Works, Brooklyn, N.Y., are: A 10,000 feet holder for the De la Mar-Mercur Mining Company, of Mercur, Utah; for the New York Sugar Refining Company, of Long Island City, 46 tanks, with a capacity considerably in excess of 1,000,000 gallons; for the Chesebrough Manufacturing Company, Brooklyn, N.Y., 96 filters.

THE Philadelphia *Ledger*, of September 28th, had the following, respecting the appropriations for the maintenance and conduct of the Philadelphia gas works for the ensuing year: "A proposed increase of certain salaries was the point upon which most of the discussion turned at the meeting of Councils' Committee on Gas yesterday, and in considering the appropriation for 1898 to the Bureau of Gas and Lighting, there was some effort to have salaries reduced. The result of the meeting, however, was to allow the appropriation of $4,545,188 asked for, an increase of $1,081,516 over the $3,463,672 appropriated last year. The item of miscellaneous salaries ($192,388) was more by $1,000 than for this year. Mr. Quick, Assistant Director of Public Works, explained the increase satisfactorily by explaining that the increase was for the specific pay of a draughtsman, who at present is being carried on the per diem list of the pay roll. In opposing an increase in the salary of the Superintendent of the Frankford plant from $960 to $1,200, Mr. Adams declared that, if the Committee favored the lease of the gas works, its attitude would best be shown by increasing salaries. He favored reductions all round, if it were necessary to do so to run the Bureau at a profit. An additional appropriation of $75,000 for wages of stokers, helpers, etc., was allowed, increasing the item from $850,000 to $925,000. The item of $1,100,000 for gas coal, an increase of $350,000 over last year, was allowed. Also the item of $325,000 for materials, supplies, etc., for improvement at works, an increase of $20,000. The next debate was over the item of $750,000 for gas manufactured by the Philadelphia Gas Improvement Company, at the 25th ward works, at 37 cents per 1,000 cubic feet. Mr. Linton moved to reduce this to $500,000. He urged that the city should make more of its own gas, and Mr. Adams asked Chief Park, of the Bureau of Gas, whether the city could not make more gas with the present force of men. 'Not with the present works,' was the reply; 'we are making all we can with the present machinery.' The Chief said a large expenditure would be necessary to put in improved machinery, and the appropriation for coal would have to be increased. Mr. Linton followed with the remark that he did not see why the city could not make water gas at as low a figure as anyone else. Mr. Lovegrove objected to cutting down the item on Philadelphia Gas Improvement Company account. He said they were committed to the contract in the amount of $750,000. He would vote for a new item of $250,000 for improving the city works, but not to cut down the item as proposed. On a call for the yeas and nays, Mr. Linton's motion was defeated by a vote of three to thirteen. The item of $150,000 for purchasing and placing of new mains was agreed to."

CHEAPER gas, as instituted this summer by the proprietors of the Poughkeepsie (N. Y.) Gas Company, seems to have worked quite unequally; but sensibly. The Company's output in the dollar division shows a gain of perhaps 20 per cent., whereas the sales between the $1.80 and $1.50 divisions show a slight decrease.

THE general returns on output received by us show uniform gains for the months of July and August, 1897, as compared with the corresponding months of 1896. The gains, too, are substantial; in that they figure out over 7 per cent.

THE construction by the Columbus (Ohio) Gas Company of the 24-inch main that is to connect the manufacturing plant with the new holder near the Hocking Valley Bridge, is well underway. In fact, it is thought that the new storage system and the connecting lines will be at work before the Christmas holidays.

JUDGE MADILL denies that any prominent capitalists of St. Louis, Mo., are concerned in the purchase and ultimate "financing" of the gas properties in Buffalo, N. Y.

THE "contest for control" at Flushing, L. I., for the gas supply of that place is still "on." The spectacle so afforded is brilliant evidence that property is worth its value. Mr. Braker and his friends meanwhile seem to have the strength at Flushing that possession gives.

MR. H. RUTHERFORD, the President of the Waverley (England) Association of Gas Managers, in his address before the 73d half-yearly meeting of that Association, speaking of the looseness of the rules that guided the operations of the ordinary gasfitter, said that in too many cases they would find the gasfitters were as ignorant of the principles of gasfitting as were their customers. He did not altogether blame the fitters, for in too many instances they were screwed down to the lowest charge for their work, and it was no wonder, under such circumstances, that they did not study the principles of their trade. As he had said, they lived in an age of improvement. They knew of the improvements that had of late taken place in the sanitary condition of their dwellings; and they knew that the plumber of to-day had to be registered as a practical plumber before he was allowed to fit up those sanitary arrangements. Why, then, should not the gasfitter be registered in the same way? He was glad to observe that the authorities of the city of Boston, U.S.A., were bringing in a scheme, providing that no gasfitter should be allowed to carry on his trade in the city unless he held a license from a Board of Examiners. He would go farther, and say that it was not only plumbers and gasfitters who should be registered, but that those who made the plans for buildings—architects and clerks of works—should also be able to know whether gasfittings were right or wrong, and should not be obliged to take the advice of those who were in charge of the gas supply, as they often did. If they were able to provide proper interior fittings, there would be fewer complaints about bad gas.

IT is said that Mr. Addicks has denied that the Queen City Gas Company, of Buffalo, N.Y., is included in the deal under which the solvent gas properties of that city are to be consolidated. He need not have denied it.

THE assessable value of the real estate on which is located the many branch plants of the Philadelphia Municipal gas works is not less than $4,000,000.

PRESIDENT KELSEY, of the Newark (N. J.) Gas Company, is home from Europe, and the thought is that important developments over the proposed further consolidation of the gas interests of Newark and Jersey City will be hastened. Those who father that hope should remember that the old Jersey City Company still maintains its individuality.

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MONDAY, OCTOBER 4, 1897.

Terms of the Coal Strike Settlement.

Iron Age says that the bituminous coal miners' strike in the West was officially declared at an end in the third week of September. The wage scale committees having in charge the work of adjudicating the differences on the various prices for mining have completed their work and the corrected scale adopted by the miners and operators is as follows:

Prices to be paid for run of mine coal, 39 cents per ton; over 1¼-inch screen, 65 cents per ton; over ¾ inch screen, 54 cents. Clay veins, 6 inches and less than 12 inches, $1.65; anything over 12 inches at the rate of $1.65 per foot. Where clay veins run in angles across room or entry, 41 cents per yard. Anything 6 inches or less shall be considered a spar, and 82 cents shall be paid. When the spar runs in an angle an additional 21 cents per yard shall be paid.

Terms of the Scale.—Room turning, neck not to exceed 7 yards, $2.06. Entry work for two men, 82 cents per yard; two additional men, $1.03; three shifts, $1.24. For 12 foot places, former price to be paid, 41 cents. Ripping roof, digging drain, thick slate moved, left to miners and mine bosses.

Scale for fourth pool, over 1¼-inch screen, 52 cents per ton; run of mine, $30\frac{6}{10}$ cents. The track layers to be based on 3 tons of coal in all veins.

Dead work for machine scale: Harrison machine, room turning, $2.39, cutter to get $1.02 and loader $1.37; entry, 58 cents per yard, of which cutter gets 17 cents and loader 44. Where paid by the ton, for entry work, 18½ cents per ton; loader to receive 13¼ cents per ton in addition to the regular price, making 45¾ cents per ton. Break throughs shall be 42 cents per yard, but where driven entry width and slate taken down the price shall be 45 cents.

Jeffrey machine, room turning, $2.03, 66 cents for cutter and $1.37 for loader; entry, 51 cents a yard; in addition to the regular price for cutter, 11¼ cents; loader, 40¾ cents; entry work by ton, 3 cents a ton additional, cutter to get 11⅛ cents and loader 13¼ cents; break throughs, 42 cents.

Pick sharpening, $1\frac{3}{10}$ cents.

The Market for Gas Securities.

The trading in local gas securities continues in line with the scenic effects that have predominated for a month or more. The low point for the week in Consolidated was 200 (one sale at which figure was reported this—Friday—morning), afterwards selling at 208, at noon; and later at 206.

The street has had many rumors accounting for the decline, but the real fact is that the weaklings who took flyers on scant margins have been forced to let go.

The newspapers, too, have had quite a bit to say about the stock, notably the *Sun*, whose daily financial fledgling writer, and whose weakly septuagenarian authority (Matthew Marshall or Mr. Babcock) have propounded their young and old beliefs.

The cold, calm fact is that no hitch which amounts to anything has occurred in the conducting of the negotiations to consolidate the gas interests of the Borough of Manhattan. The consolidation is to all intent and purpose virtually accomplished, and the cheapest stock on the list to-day is Consolidated gas, at the quoted rate—206¾.

We do not address ourselves in this column to speculators, but offer whatever advice we may to investors; and our belief is that we know quite as much about the governing and influencing conditions of New York city's gas supply and the financing of its gas properties as does Mr. Marshall.

The property of the Northern Company has been acquired by the combination, and Mr. Bush is the picture of virtue rewarded. He deserves quite some commendation for his pluck.

Brooklyn Union is down to 123 bid; it is full seven points below its real worth.

Chicago gas is wobbling with the rest, the noon rate to day being 98⅝ to 98½.

Bay State gas is staggering under its new capital load; all things considered, however, it is doing fairly well.

Detroit and Lacledes are weaker. In fact the whole list favors the bears.

A marked instance of nominal weakness is afforded in the quotations for Indianapolis gas, which is returned at 120 to 129. Judged by its real value, 150 would not be too much for it.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

OCTOBER 4.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	208	208¼
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	280	290
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	340	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	85	90
Preferred	2,000,000	100	110	114
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	105	106⅛
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	.
Standard	5,000,000	100	130	137x
Preferred	5,000,000	100	140	150
Bonds, 1st Mortgage, 5's	1,500,000	1,000	114	115
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	123	123⅛
" " Bonds (5's)	15 000,000	1,000	113	114
Bay State	15,000,000	50	8⅞	9¼
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	93	..
2d " " " "	3,000,000	1,000	80	81
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	98⅝	98⅞
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	104	104¼
Columbus	1,069,000	.	93¼	93½
1st Mortgage	1,085,000	..	..	96
Consumers. Jersey City	2,000,000	100	75	85
" Bonds	600,000	1,000	103	105
Cincinnati G. & C. Co.	8,500,000	100	203⅛	203¾
Consumers, Toronto	1,000,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	59½	60
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000		47	48
" Con. Bonds	4,312,000	..	93½	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	83	84
" Bonds	2,000,000	..	93	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	120	129
" Bonds, 6's	2,650,000	..	107	109
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	88	90
Bonds	1,000,000	1,000	92	94
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	42½	43
Preferred	2,500,000	100	93	93
Bonds	9,034,400	1,000	103½	..
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	142	..
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87⅞	90
San Francisco, Cal.	10.000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	31	33
Bonds	1,000 000		98	100
Washington, D. C.	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	86½	87½
Bonds, 5's	3,556,000	.	98	100
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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 813 DREXEL BUILDING, PHILA., Sept. 22, 1897.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on Oct. 15, 1897, to stockholders of record at the close of business Sept. 30th. Checks will be mailed.

1164-3 EDWARD C. LEE, Treasurer.

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Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

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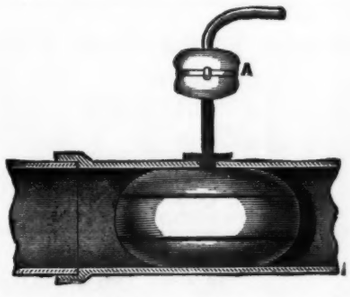

These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and some times fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in. Gas Bag, each,			$0.60	12-in. Gas Bag, each,			$5.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

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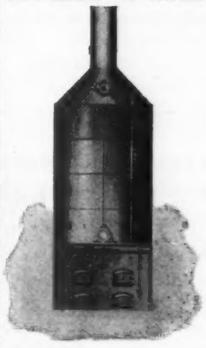

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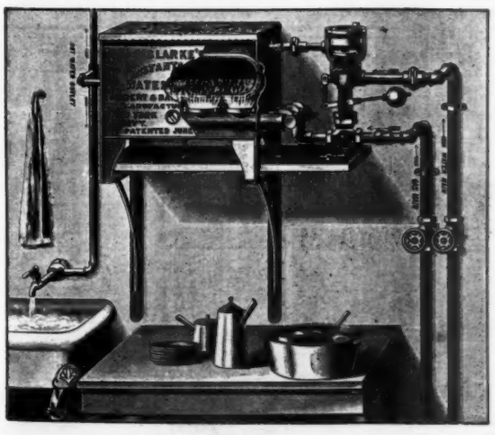

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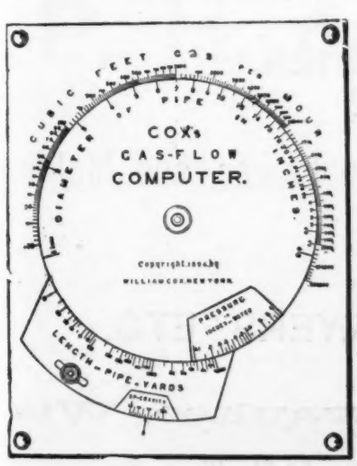

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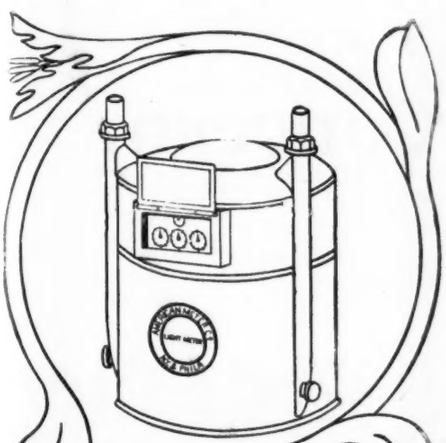

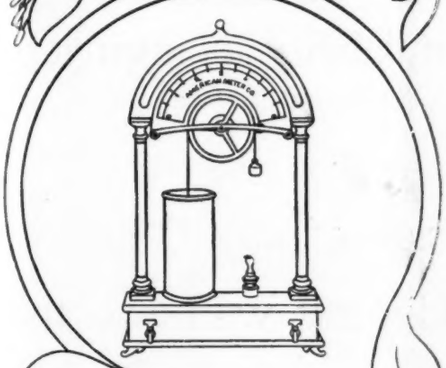

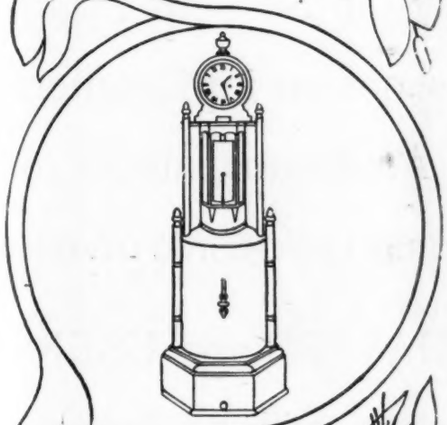

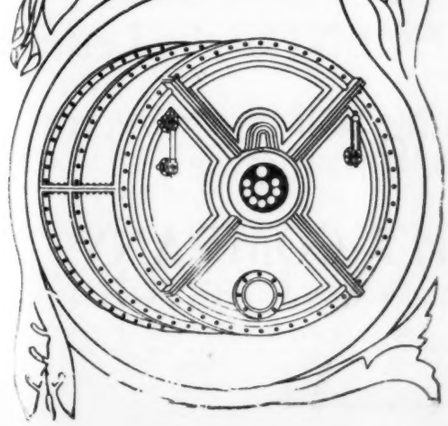

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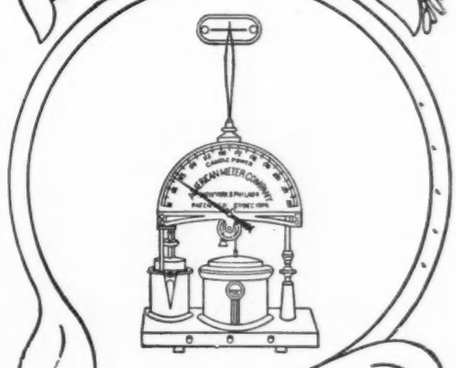
PUBLIC LIGHTING TABLE.

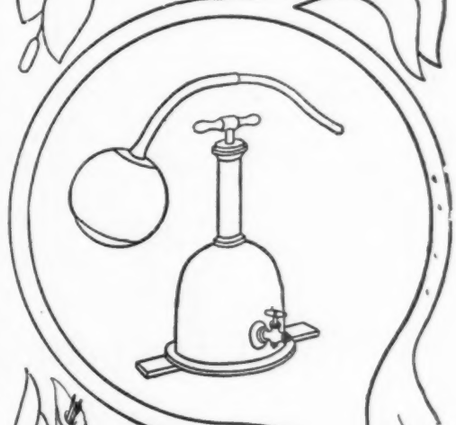
OCTOBER, 1897.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	8.10 PM	5.00 AM	5.30	5.00
Sat.	2	9.20 FQ	5.00	5.30	5.00
Sun.	3	10.30	5.00	5.30	5.00
Mon.	4	11.40	5.00	5.30	5.00
Tue.	5	12.50 AM	5.00	5.30	5 00
Wed.	6	1.50	5.00	5.30	5.00
Thu.	7	3.00	5.00	5.30	5.00
Fri.	8	4.00	5.00	5.20	5.10
Sat.	9	No L.	No L.	5.20	5.10
Sun.	10	No L. FM	No L.	5.20	5.10
Mon.	11	No L.	No L.	5.20	5.10
Tue.	12	5.50 PM	7.00 PM	5.20	5.10
Wed	13	5.50	7.40	5.20	5.10
Thu.	14	5.50	8.20	5.20	5.10
Fri.	15	5.50	9.00	5.10	5.20
Sat.	16	5.50	10.00	5.10	5.20
Sun.	17	5.40	11.00	5.10	5.20
Mon.	18	5.40 LQ	12.00 AM	5.10	5.20
Tue.	19	5.40	1.00	5.10	5.20
Wed.	20	5.40	2.10	5.10	5.20
Thu.	21	5.40	3.20	5.10	5.20
Fri.	22	5.40	5.20	5.00	5.30
Sat.	23	5.40	5.20	5.00	5.30
Sun.	24	5.30	5.20	5.00	5.30
Mon.	25	5.30 NM	5.20	5.00	5.30
Tue.	26	5.30	5 20	5.00	5.30
Wed.	27	5.30	5.20	5.00	5.30
Thu.	28	5.30	5.20	5.00	5.30
Fri.	29	5.30	5.20	4.45	5.35
Sat.	30	8.20	5.20	4.45	5.35
Sun.	31	9.30	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45





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WE have learned that the makers of the "Sunlight" lamp assert that there has been a decision in the English Courts which saves them and their customers from liability as infringers of the Welsbach patents.

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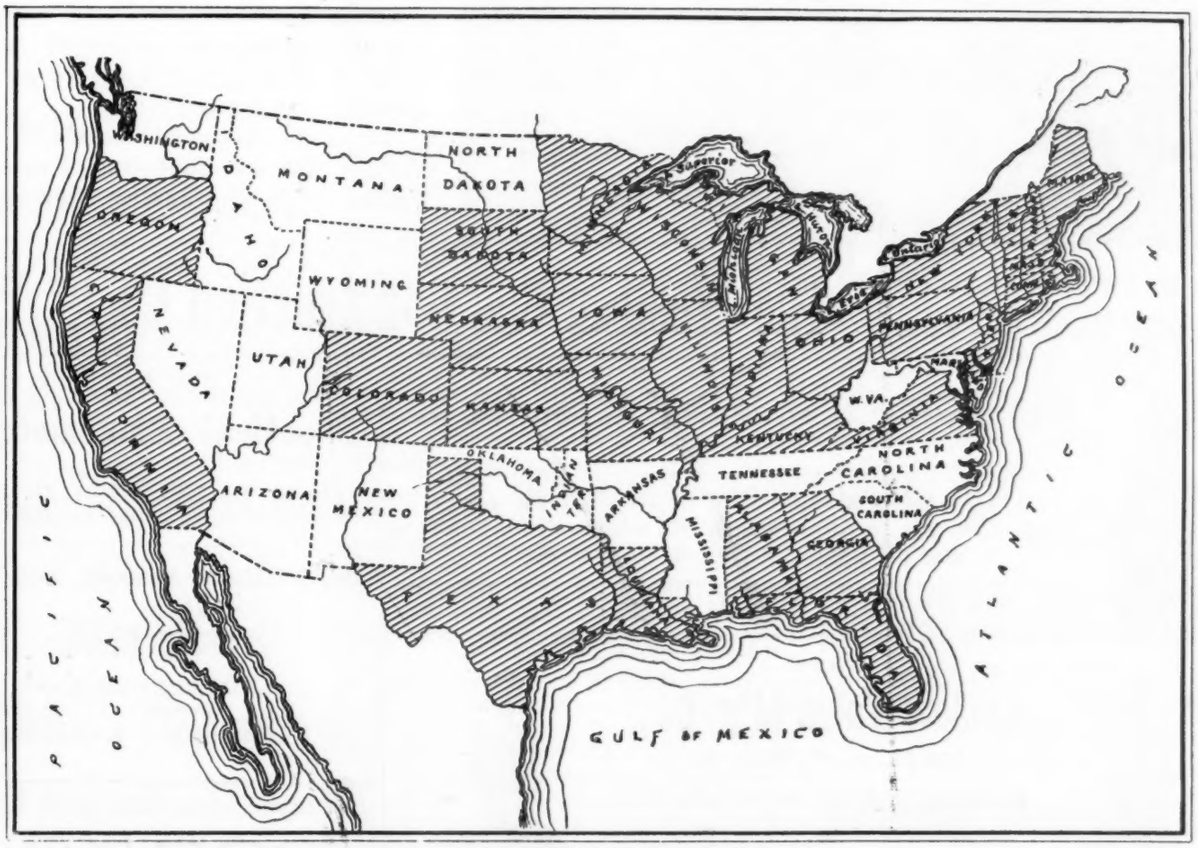

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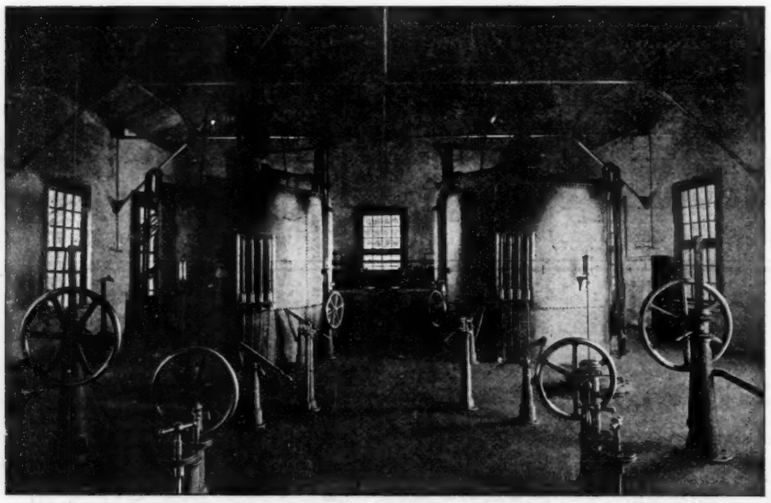

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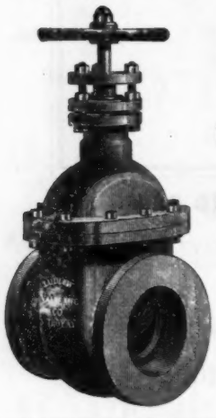

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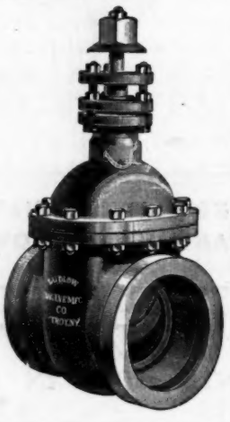

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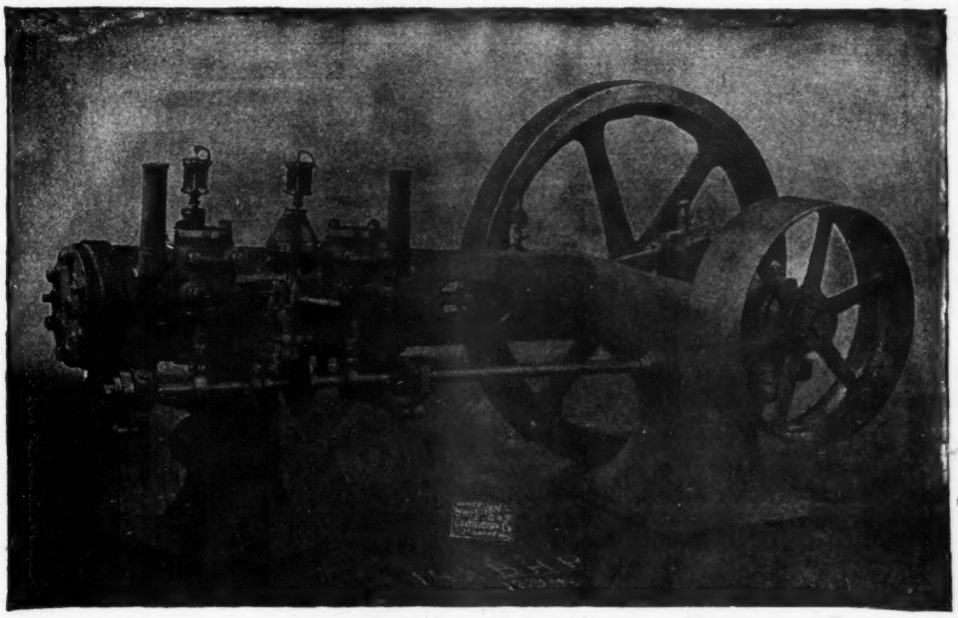

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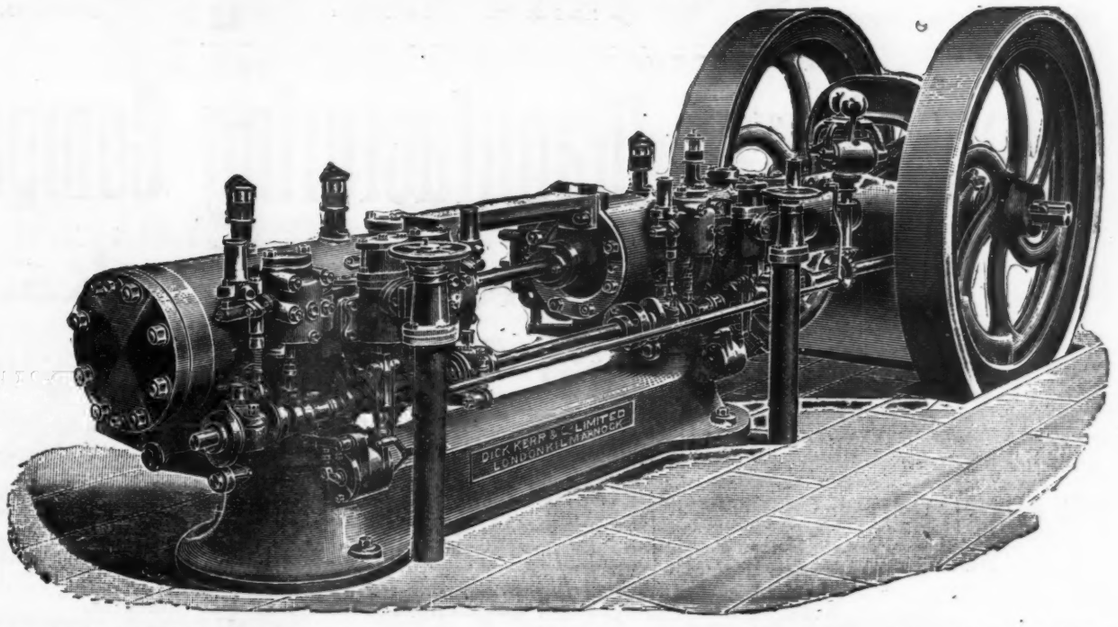

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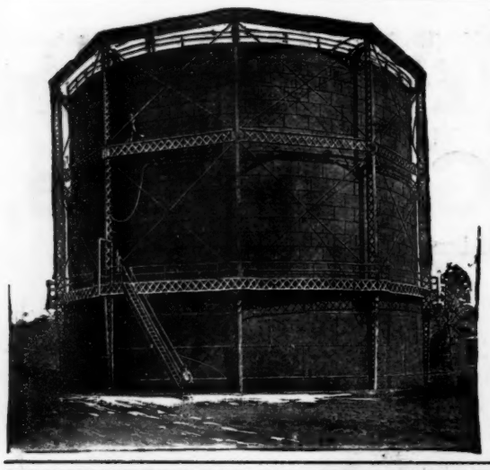

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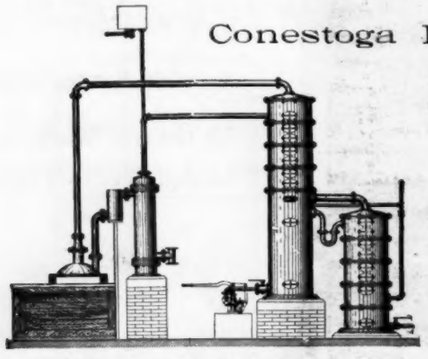

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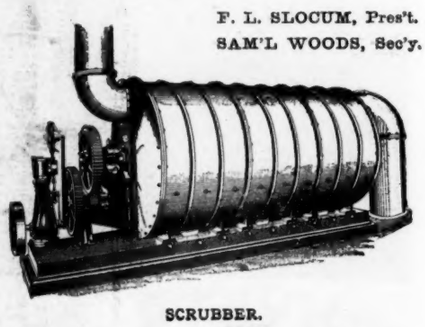

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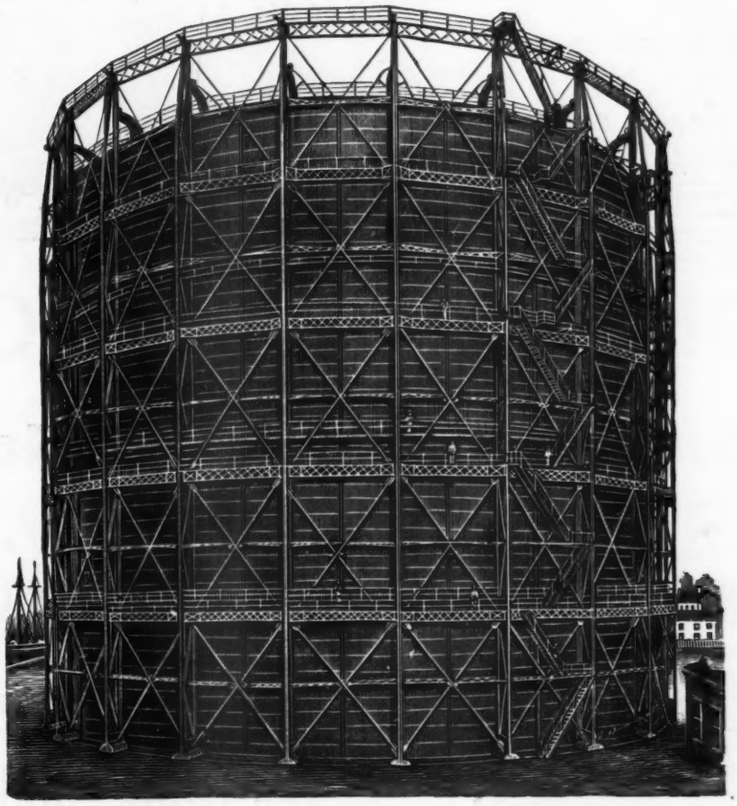

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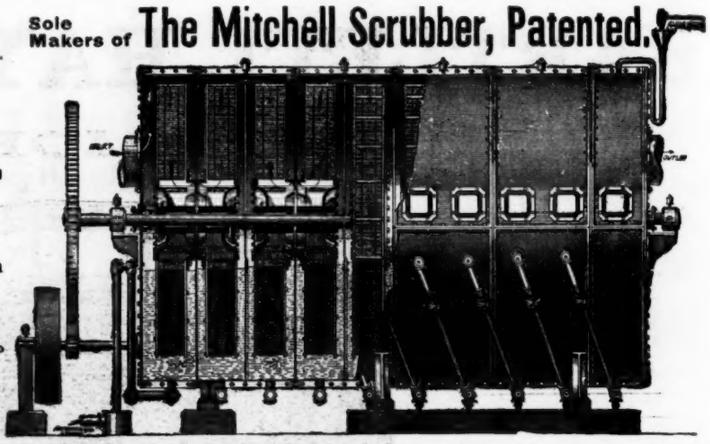

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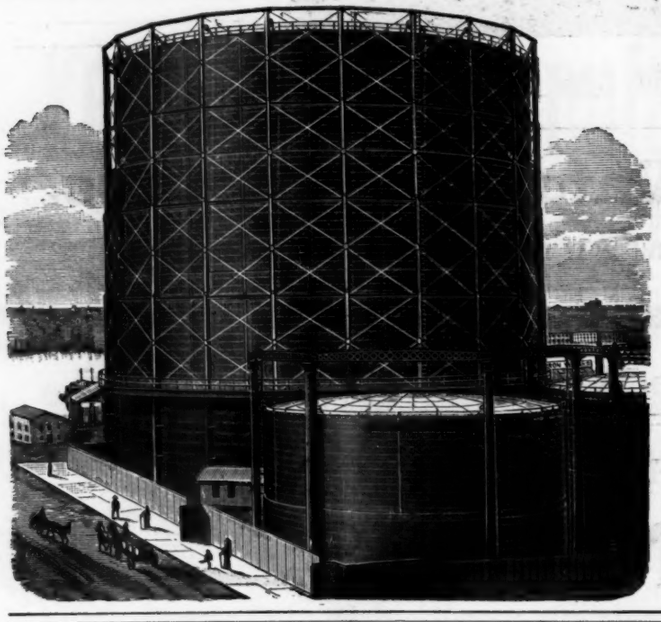

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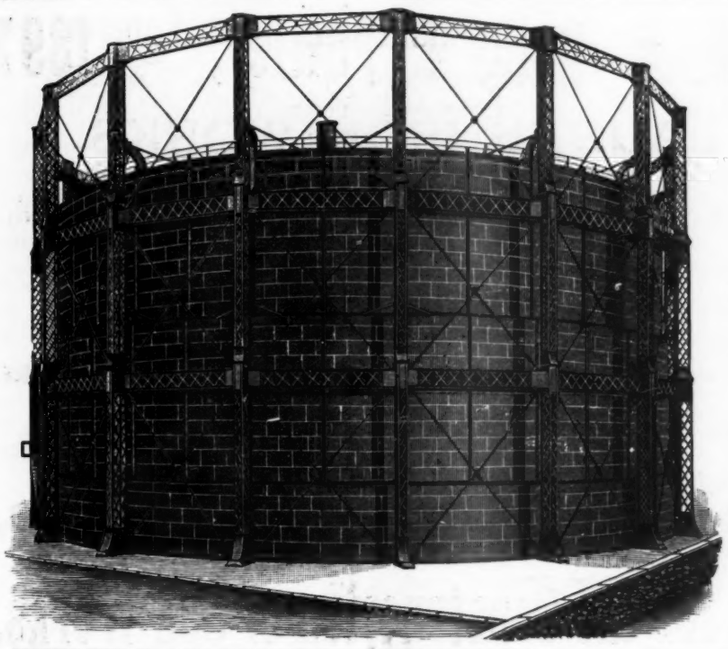

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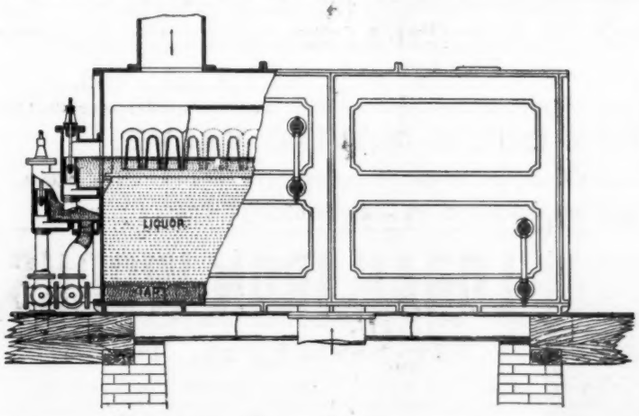

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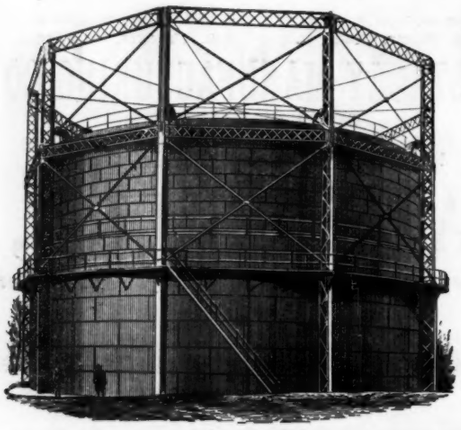

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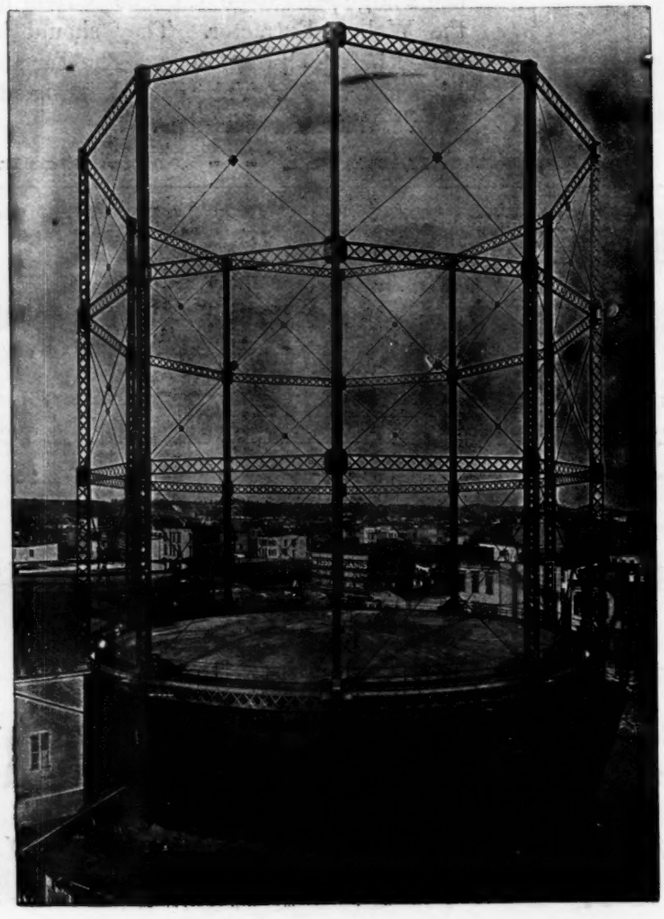

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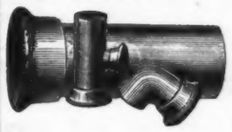

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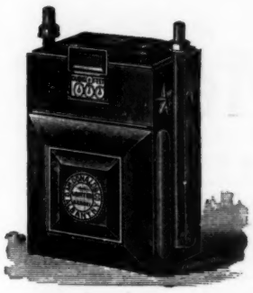

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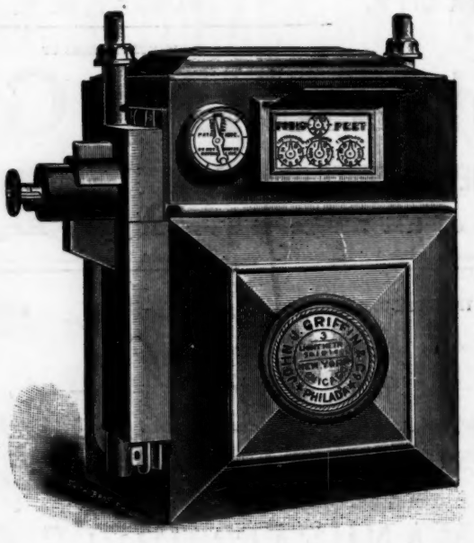

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